TRANSACTIONS AND PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(INCORPORATED)

VOL. LVIII.

[*Each Author is responsible for the soundness of the opinions given, and for the accuracy of the statements made in his paper.*]

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Parcels for transmission to the Royal Society of South Australia from the United States of America can be forwarded through the Smithsonian Institution, Washington, D.C.

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[WITH PORTRAIT, TEN PLATES, AND THIRTY-TWO FIGURES IN THE TEXT]

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A

ROYAL SOCIETY OF SOUTH AUSTRALIA

(INCORPORATED).

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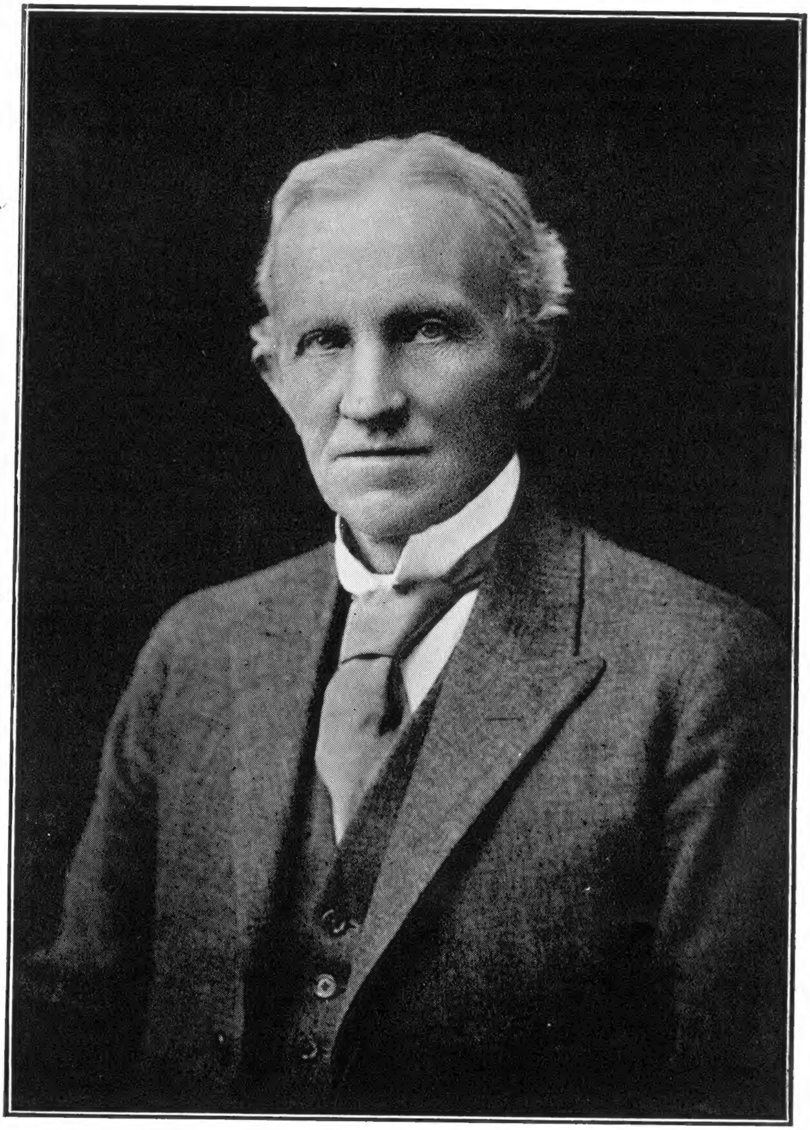

SIR TANNATT WILLIAM EDGEWORTH DAVID, K.B.E., C.M.G., D.S.O., D.Sc., ETC.

OBITUARY NOTICE.

SIR TANNATT WILLIAM EDGEWORTH DAVID, K.B.E., C.M.G., D.S.O., D.Sc., F.R.S., etc. (1858-1934).

WITH PORTRAIT AS FRONTISPIECE.

The sudden passing of Sir Edgeworth David has brought to a close a life of extraordinary activity that found spheres of usefulness in manifold directions, and has left a vacancy in the scientific ranks of Australia that is very difficult to fill.

The subject of our Obituary Notice was the son of the Rev. William David, M.A., rector at St. Fagan, a small village situated about five miles from Cardiff, in South Wales. He was born at the Rectory in 1858, was educated at Magdelen College School and New College, Oxford, where he distinguished himself both in his studies and in athletics. His father had a predilection for fossils, and made a valuable collection of these from the surrounding country, which was noted for such remains. He caught his first enthusiasm for geology from Prof. Sir Joseph Prestwich, whose lectures he attended and took advantage of the presence of members of the British Geological Survey, who were stationed in his neighbourhood, to get initiated into the methods of geological field work. He graduated as Bachelor of Arts in 1880, and obtained a First Class in Classics in the Honours Examination.

It was in South Wales that he found his first insight into the evidences of extinct glacial action, which came as a revelation to him from the moraines and erratics of his native land. He was the first field geologist to make such local and detailed observations, and he embodied his notes in his first scientific paper read before The Cardiff Naturalists' Society, in 1881, which was followed by more extended notes published in the Journal of the Geological Society of London, in 1883, of which Society he had been elected a Fellow the same year.

In 1882 the office of Assistant Geological Surveyor in New South Wales was vacant, and enquiries were made in England as to suitable candidates, and on the recommendation of Prof. Sir Joseph Prestwich and Prof. Boyd Dawkins, David was appointed to the office, at 24 years of age. He entered with great zest into the discharge of what was to him congenial duties, stimulated by the new aspects of geology that were before him in these southern lands.

As a Geological Surveyor under Government control he was required to give special attention to such branches of the subject as had an economic value, and the nine years he spent in the Public Service were spent mainly in that direction, but he invariably based his work on sound scientific principles. Among the more important monographs that he published during this period were: "The Geology of Vegetable Creek Tin-Mining Field, New England District, with Maps and Sections," a most exhaustive work; and the still more important monograph on "The Geology of the Hunter River Coal Measures, with Maps, Plates, and Sections"; a great work in which the author not only elaborated those parts of the coal resources of New South Wales that were already known, but was successful in the discovery of coal deposits where they had not been previously suspected to occur, and gave rise to the development of the important group of collieries based on the Greta Coal Measures.

In 1891 the University of Sydney wisely considered that a geologist of such exceptional abilities and enthusiasm could find a more extended usefulness as the occupant of a professorial chair in the University, and was justified in this by the happy results that followed. Professor David possessed not only an unlimited enthusiasm in the pursuit of his favourite subject, but by a personal magnetism infused the same spirit into his students, who came to look upon their studies not as tasks but as fascinating researches into the hidden paths of Nature.

One of the distinctve features of his mental tendencies was the power of generalization. He was not satisfied to take in the geological evidences of a single locality, but he immediately sought to correlate one geological region with others, and thus established definite geological provinces which took in all the States. In this aspect of his work he may be regarded as the Suess of Australia, for all the States have benefited by his constructive methods.

The British Expedition to Funafuti, in 1886, to test the validity of Darwin's theory of coral reefs, having failed to reach any considerable depth, the University vacation in the following year presented the opportunity for an Australian Expedition, under the leadership of Professor David, to make a second attempt; after a depth of about 600 feet had been reached, the University contingent had to return to duties in Sydney. Later, the boring was continued under the direction of Mr. A. H. Halligan, of Sydney, and was successful in reaching a depth of over 1,100 feet. The persistent advocacy of this object and its successful accomplishment were largely due to Professor David's enthusiasm, towards the cost of which he had largely contributed from his private means.

The fascinating subject of past glacial action in low latitudes, which began in his experience while still a lad, held him in its spell all the rest of his life. In 1897 he suggested to the writer that an attempt should be made to locate the glaciated rock in the Inman Valley discovered by Selwyn, in 1859. By arrangement we joined in this excursion, and although the actual polished rock seen by Selwyn was not seen (that came later) other glaciated faces were discovered, and many immense erratics located on the hillsides, which abundantly confirmed Selwyn's determination.

But the greatest thrill that came to him, in this particular aspect of his science, was the announcement by the writer that he had discovered an ancient tillite in rocks bordering on the Pre-Cambrian Age. The Professor took the earliest opportunity of visiting the evidences in the valley of the River Sturt and in the ranges near Petersburg. Many other visits were made to South Australia, and I have never seen him in a greater state of excitement than when handling a polished and ice-scratched erratic taken freshly out of the tillite. He concentrated much attention on the boulder-bearing beds that are interbedded with the Coal Measures of New South Wales, tracing them down through the Permian series to the Carboniferous. He elucidated the wonderful Permo-Carboniferous glacial deposits in Tasmania; when there was a warm dispute as to whether glaciers formerly lined the sides of Kosciusko, his examination of the field, descriptions, photographs, and measurements, made under even some risk to life, is a classic in this subject. Not content with the Australian evidences of Permo-Carboniferous glaciations—the greatest of all Ice Ages that the world has seen—he paid a visit to Central India to examine the Talchir Tillites (which are also classed as of Permo-Carboniferous Age), a visit that, unfortunately, had to be taken

in the rainy season, which involved much hardship and even serious risks from the flooded states of the rivers.

On two other occasions than the Selwyn episode mentioned above, Prof. David was called on to investigate glacial questions in South Australia. One of these concerned the geological age of the Hallett's Cove glaciation. Prof Tate had advocated that this glaciation was post Miocene. A visit to the spot by the members of the Australasian Association for the advancement of Science, in 1893, gave rise to a lively discussion on the subject, and the Association, in Council, passed a grant of money to clear up the question. In the following year Prof. David took charge of the operations, which involved the clearing away of the talus that had obscured the stratigraphical relationship of the tillite with the associated fossiliferous rocks, the result being the clearest proof that the glacial beds underlaid the fossiliferous Lower Pliocene (Tate's "Miocene"). The other occasion in which Prof. David was delegated to investigate reported glacial evidences in South Australia, arose out of conflicting testimonies as to whether there was, or was not, such evidences at Crown Point, on the Finke River, in Central Australia. The Australasian Association having set apart a small monetary grant for investigation, and authorised Prof. David and the writer to undertake the expedition, the locality was visited in 1922, with the result that the glacial evidences (of assumed Permo-Carboniferous Age) were much more extensive and convincing than had previously been recognised.

The absorbing interest that the Professor took in glacial questions led him to join Shackleton's First Expedition to the Antarctic (1907-9), and at the age of 51 faced the rigours of an Antarctic winter and took his full share in the daily duties of the Expedition. He was one of the party that climbed Mount Erebus and gazed into its ancient crater; he was also the leader of the party that discovered and located the position of the South Magnetic Pole. His official report, as Geology, vol. i., of the Expedition, is one of the most comprehensive, profusely illustrated, and interesting volumes in the literature of the Antarctic.

At the outbreak of the Great War his loyal enthusiasm and fruitful resources led him to play his part in that great struggle. Too old to join the ranks, he joined the corps of Mining Engineers of the A.I.F., under Lieut.-Colonel Fewtrell, in the rank of Major, as geological expert, and at the same time used his influence in securing the addition of many of the University students to this branch of the army. The accomplishments of this corps, not only in effecting the tremendous Messines explosion that did such damage to the enemy's lines, but also on the vital questions of underground waters, and their seasonal variations in the great chalk beds, having the most vital bearings on tunnelling and underground safety; in all these matters the expert knowledge of the Professor was of the highest value, and for this he was mentioned in Dispatches. It was in the discharge of these duties that Prof. David met with his serious accident by falling down a shaft, 80 feet deep, and received injuries that caused increasing disabilities and suffering throughout the rest of his life, and no doubt hastened his end.

During the latter part of his life (it may safely be said that for at least ten years) Prof. David had begun systematically to collate the geological data of the Australian continent in a connected whole, for which his great powers of generalization were eminently adapted. Concurrently with his preparation of a detailed Geology of the Commonwealth, which was intended to take the form of a three volume work, he was intently engaged in producing a detailed geological map of the whole of Australia, which, fortunately,

was completed and published during his life time. The President of the Geological Society of London (Sir Thomas H. Holland), in his Anniversary Address, just published, stated, "Australia alone among the Dominions has no Commonwealth Geological Survey. Providence has, however, lent it temporarily the services of Sir Edgeworth David, who is possibly the only man living who could have correlated the scattered State records to produce a geological map of the whole Commonwealth like that which he published two years ago." Together with this great map is published a volume of "Explanatory Notes," which supplies a key to the map, and at the same time a summary of the most trustworthy and up-to-date facts relating to the geology of Australia as a whole. Unfortunately the author had not lived to see his great work published, but, fortunately, it is left so near completion that, it is hoped, those of his colleagues who have collaborated with the author in finalizing his efforts will be able to see it through the press practically as the author desired.

Sir Edgeworth David's distinguished scientific qualities were associated with great personal charm. To render a service to others, whether in friendship or in scientific helpfulness, gave him the greatest of pleasure. The very generous way in which he always recognised the work of others who may have been over the scientific field before him, won the hearts of his colleagues and stimulated the efforts of his students. He was a most welcome guest and delightful companion. With a rich anecdotal lore, largely drawn from his own experience, and given in an inimitable style, his conversation was full of interest and character.

He participated in many well-deserved honours. From Royalty he received his C.M.G. in 1910; D.S.O. in 1918, and K.B.E. in 1920. He was awarded the Conrad Malte-Brun Prize by the Geographical Society of France; the Wollaston and Bigsby Medals by the Geological Society of London; the Müeller Memorial Medal by the Australasian Association for Advancement of Science; the Clarke Memorial Medal by the Royal Society of New South Wales; he was elected an F.R.S. in 1900; Hon. D.Sc. (Oxen.) in 1911; an Hon. Fellow of this Society in 1897; was twice President of the Aus. Assoc. Ad. Sc. (a unique honour); and President of other learned societies and scientific movements in various parts of Australia.

The Members of the Royal Society of South Australia mourn their loss, and tender to Lady David and the other members of his bereaved family its most heartfelt sympathies.

W. HOWCHIN.

October, 1934.

THE ARLTUNGA AND KAROONDA METEORITES.

BY D. MAWSON, KT., D.SC., F.R.S.

Summary

This siderite was found by Dan Pedler about the month of September, 1908, and came under notice of the Mines Department. The Government Geologist, the late Mr. H. Y. L. Brown, referred the discoverer to the South Australian Museum, with the result that the meteorite was purchased by that institution in November of the same year. The find was located some two miles south of the Government Cyanide Works at Arltunga, a mining centre in the eastern end of the MacDonnell Ranges, Central Australia. The geographic position may be taken at latitude 23° 28' S. and longitude 134° 40' E.

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THE ARLTUNGA AND KAROONDA METEORITES.

By D. Mawson, Kt., D.Sc., F.R.S.

Plates I. to III.

[Read November 9, 1933.]

I. The Arltunga Meteorite.

This siderite was found by Dan Pedler about the month of September, 1908, and came under notice of the Mines Department. The Government Geologist, the late Mr. H. Y. L. Brown, referred the discoverer to the South Australian Museum, with the result that the meteorite was purchased by that institution in November of the same year. The find was located some two miles south of the Government Cyanide Works at Arltunga, a mining centre in the eastern end of the MacDonnell Ranges, Central Australia. The geographic position may be taken at latitude 23° 28′ S. and longitude 134° 40′ E.

The iron mass was reported to have cut its way obliquely into the ground for a depth of about five feet, excavating a groove, at one end of which it was seen to be embedded with but a small corner projecting from the soil. It was not seen to fall, but must have arrived within a short time of its discovery—certainly not more than several years, and probably considerably less—else the groove scored in the ground would have become obliterated by wind-blown sand and wash. The date of the fall may, therefore, be placed at about 1907-1908.

The weight of the original entire meteorite amounted to almost exactly forty pounds. It is of a solid squat shape with a flat base 26 cms. by 16 cms., from which it rises as an irregular tapering form to a blunt ridge 14 cms. above the base. The surfaces are generally smooth (pl. ii., fig. 1) there being no definite pits, only broad, shallow depressions and convexities. It may have traversed the atmosphere with the flat base to the rear, but there is no evidence, by markings on the surface, of the direction of passing air currents. Also there are no markings definitely indicating the point of impact with the ground.

The surface of the metal is cased in a very dark-coloured oxidization (by heat) crust, magnetite, under one millimetre in thickness. This is surmounted, here and there, by patches of a thin reddish oxidization veneer resulting from further oxidization by weathering.

The specific gravity of the unoxidized meteorite material was ascertained to be 7·848, and an analysis made by Mr. W. T. Chapman, late analyst to the Mines Department, gave the following result:—

Iron (Fe)	88·06%
Nickel (Ni)	10·22%
Cobalt (Co)	1·01%
Chromium (Cr)	0·26%
Phosphorus (P)	0·24%
Sulphur (S)	not det.
Insoluble in *aqua regia*	0·01%
Total	99·80%

An examination of polished plates viewed under the microscope establishes the fact that almost the entire mass is composed of nickel-iron alloys, there being only minute quantities of other substances. A few tiny patches, circular in outline and not exceeding 0·5 mm. diameter, are visible occupied by a brittle, black substance which is non-magnetic and dissolves in dilute nitric acid with the evolution of some hydrogen sulphide. This mineral is taken to be daubréelite, a double sulphide of iron and chromium. Further, an acid etch brings into relief scattered minute grains of a tin-white, metallic mineral very resistant to the solvent. These grains are evidently schreibersite, a phosphide of iron, nickel and cobalt.

Polished plates, when etched with very dilute nitric acid, become finely frosted in appearance (pl. i., fig. 1). To the naked eye there is no evidence of Widmanstätten figures or other coarse structure, though the percentage of nickel plus cobalt falls within the usual range of octahedrites. Lack of macroscopic structure is sufficient to relegate this siderite to the group known as ataxites. However, upon further investigation of the etched surface at high magnification, the existence of an interesting micro-structure is revealed. Thus at 100 times the actual dimensions (pl. i., fig. 2) rods and blebs of a brightly reflecting nickel-iron alloy moderately resistant to the attack of dilute acid are seen to be arranged in definite microscopic pattern. At 200 diams. (pl. i., fig. 3) the octahedral character of the pattern is clearly defined. At 500 diams. (pl. i., fig. 4) the more intimate nature of the arrangement is revealed. The texture is seen to be chiefly defined by the alignment of most of the nickel-iron alloy richest in nickel (apparently taenite) in octahedral fashion. The bulk of the intervening material is a microscopic intergrowth of some taenite with a duller, more soluble ferro-alloy of lower nickel content, probably of the general composition of kamacite.

The several constituents appear to be represented in the following approximate proportions:—

Kamacitic nickel-iron - - -	65%
Taenitic - - - - -	33%
Daubréelite - - - - -	$\frac{2}{3}$%
Schreibersite - - - - -	$\frac{1}{3}$%

The etched plates do not reveal any obvious suppression or modification of the crystalline structure in the marginal zone adjacent to the skin of the meteorite. In the case of meteorites exhibiting coarse Widmanstätten figures within, the structure often fades out in proximity to the margin, a feature ascribed to molecular re-arrangement under heat stress as it traversed the atmosphere.

The question arises as to whether the micro-octahedral structure of this meteorite is of primary or secondary origin. It can be conceived as possibly developed as a secondary structure from an original normal octahedrite that has recrystallized in the solid state under some degree of reheating. In this case the octahedral orientation of some of the elements would be of the nature of a "relict" structure analogous to phenomena met with in the case of certain metamorphosed rocks.

With regard to classification, two alternatives are suggested. Siderites with the structure here represented may be regarded either as a variety of the ataxites; or else classed under the term micro-octahedrites, as a special division of the octahedrites.

II. The Karoonda Meteorite.

The Karoonda meteorite is an aerolite of uncommon type. Interest in it is further increased by reason of its fall having been observed, and the phenomena associated therewith having been ably recorded[1] by Professor Kerr Grant and Mr. G. F. Dodwell. It was observed to arrive as a brilliant fireball, witnessed over a radius of more than 250 miles in southern South Australia, at about

[1] "Nature," 1931, vol. cxxvii., p. 402-403.

10.53 p.m. on the evening of November 25, 1930. After examining the evidence, Grant and Dodwell conclude that "the meteorite appears to have descended at a steep angle of about 70° with the horizontal. When first seen it had an altitude of 150 miles or more, and the duration of the fall was approximately six seconds. It travelled in an east-south-east direction.

"When first seen the meteorite compared in brightness with a star of first or second magnitude but rapidly (in a few seconds) increased to a brilliancy which gave an illumination comparable to that of daylight, even in Adelaide. It was described by many observers as an immense ball of bluish-white colour, equal in diameter to the full moon, and having a luminous tail several degrees in length. As it approached the earth showers of sparks issued from the main body."

Observers within a few miles of the location of the fall reported a loud rumbling or roaring noise. Messrs. Honeyman and Millard, of Karoonda, who were nearer to the locality of the fall than any other observers (2¼ miles distant), give the following account:—". . . the disappearance[2] of the meteorite was followed by a loud detonation as though a very heavy charge of explosive had been let off underground. This caused a distinct vibration of buildings nearby. This sound was followed, at an interval of about three seconds, by a loud cracking and rending sound from the sky in the direction in which the meteorite was last seen, then by a low rumbling of thunder which gradually died away in the distance."

Visible and audible phenomena pointed to impact having taken place in the vicinity of Karoonda, and with a view to retrieving the meteorite, Professor Kerr Grant and Mr. Dodwell led a search party from Adelaide. On the third day of search they were successful in locating the fall at a point 2¼ miles east of the township of Karoonda. The meteorite was lying in sandy farm land. "It had made a crater-like hole in the sand eighteen inches in diameter and about the same depth, with a surrounding ridge of sand three feet six inches across."

"The meteoritic stone had shattered on striking the earth, and numerous fragments were scattered over a radius of four or five feet. The bulk of its mass, however, was within the crater, the largest fragments being on the east side and pointing nearly vertically down. In addition to pieces varying from an ounce or two to seven pounds in weight, there were very numerous smaller fragments and much finely pulverized material mixed with sand. The whole was collected and the meteoritic material separated from the sand in a magnetic separator. The total weight of the meteorite was thus ascertained to have been 92 pounds."

As it was shattered on impact, the original shape of this meteorite is not known. One large fragment exhibits portion of two original faces. The illustration (pl. ii., fig. 2) shows the appearance of these two faces respectively, and the edge along which they meet. The deeply scored nature of the face exposed to the rush of air is very noticeable, as it is seamed with deep, oval pittings. The other smooth face was evidently in the rear of the advancing meteorite. Just around the edge where the side and rear face meets is a thickening of the scoriaceous crust, representing an accumulation of fused matter swept back from the friction-stressed, forward-facing part of the mass.

The fused crust is of a dark grey to nearly black colour, being distinctly blacker on the rear face, where it is thicker. It usually exceeds 1 mm. in thickness on the latter face, whilst on the forward faces it is scarcely more than a varnish, being everywhere less than 0·5 mm. in thickness. It is, everywhere, only loosely adhering to the meteorite substance within, so that it readily scales off.

The material of the meteorite itself is of a medium- to dark-grey colour, and is rather friable. This friability is doubtless due, at least in part, to the effect of

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(2) Cessation of luminosity due to impact with the ground. (D. M.)

its violent impact with the ground. Porosity is more marked than in the case of normal terrestrial rocks, but this may be due to the shattering effect of shock. No obvious nickel-iron is observable in the microscopic examination. It is practically an all-stone meteorite with abundant rounded chondri which on fracture faces (pl. iii., fig. 1) stand in relief, the chondri not breaking with the matrix.

Mr. A. R. Alderman, M.Sc., has made for the South Australian Museum a complete chemical analysis, indicating the following percentage composition:—

Silica (SiO_2)	34·36
Alumina (Al_2O_3)	5·55
Ferrous oxide (FeO)	26·99
Magnesia (MgO)	24·85
Lime (CaO)	2·58
Soda (Na_2O)	0·71
Potash (K_2O)	0·26
Water (H_2O)	0·13
Titania (TiO_2)	trace
Phosphorus Pentoxide (P_2O_5)	0·25
Ferrous sulphide (FeS)	3·98
Manganous oxide (MnO)	0·21
Chromic oxide (Cr_2O_3)	0·49
Carbon (C)	0·08
Iron (Fe)	0·42
Nickel (Ni)	0·02
Total	100·88

In this analysis the carbon was determined by F. L. Winzor, B.Sc., and the phosphorus by R. G. Thomas, B.Sc.

A specific gravity of 3·5 was obtained as the mean of several determinations. In each case the meteorite fragments were first boiled in distilled water under reduced pressure, in order to eliminate the effect of the porosity of the meteorite.

The microscope section reveals a very fine-grained, brecciated structure with abundant chondri scattered through the mass. As seen in the microscope slide, some of the chondri are perfectly circular in outline (pl. iii., fig. 2), others are subcircular, and all are more or less rounded in outline. The mineral particles composing the chondri usually appear as granular aggregates, but some are radial lamellar in structure. Chrysolite is the principal constituent of the chondri. There is always present in some quantity an impregnation of troilite, which substance is prone to be concentrated around the borders of the chondri.

The brecciated material composing the bulk of the aerolite contains some larger recognisable mineral fragments set in a denser base. The latter consists of small mineral particles, rendered dusty and more or less opaque by abundant impregnations of troilite, also scattered black opaque specks representing chromite, some magnetite and what seems to be carbonaceous matter.

Though crumbled chrysolite composes most of the base, there is some dusty glass and faintly doubly refracting mineral. Occasional particles exhibit faint polysynthetic twinning. The best example of this kind has the optical properties of a basic plagioclase. Acid attacks the weakly refracting mineral and it appears to be in the main some relative of the melilite group. The evidence of the microscope slide, therefore, is that the bulk of all the alkalies, lime and alumina are combined with silica to form a little plagioclase felspar and larger quantities of an unsaturated silicate and (or) glass with a melilite-like composition.

The iron and magnesium is almost entirely present in the form of a highly ferriferous chrysolite. There are however, in small amount, particles appearing

to have lower double refraction and a higher resistance to acid, which qualities suggest hypersthene. The latter has the same straight extinction and sign as has the ferriferous olivine.

These observations, considered in conjunction with the analysis, suggest the percentage composition to be roughly as follows:—

Chrysolite (and perhaps a little hypersthene) -	82
A melilitic and felspathic fraction, say - -	12
Troilite - - - - - -	3·98
Chromite - - - - - -	0·67
Apatite - - - - - -	0·67
Nickel iron - - - - -	0·44
Amorphous carbon - - - -	0·08
Magnetite, little but uncertain - - -	?
	99·84

As to the classification of this aerolite, if catalogued on the Rose-Tschermak-Brezina system[3] it might be distinguished as a friable, dark grey, chassignitic chondrite; the chondri not breaking with the mass and nickel-iron almost wholly absent.

Recognising, however, that this system of classification, so far as the division of the chondrites is concerned, is unsatisfactory,[4] it would seem that a more simple treatment of chondritic aerolites can be applied. The division of aerolites into two main groups, sideritic and asideritic, respectively, would be a first step. The term asiderite has been applied[5] to aerolites that contain no (or only traces of) metallic iron. Prior's scheme of classification for the sideritic chondrites would then apply so far as that division is concerned. The asiderites could then be listed as chondritic or achondritic, and further divided on the basis of mineral content or of relative values of the principal chemical constituents. Simply described, ours would be a chondritic asiderite.

DESCRIPTION OF PLATES.

Plate I.

Polished and etched slice of the Arltunga meteorite, viewed at various magnifications, illustrating its micro-octahedral character.

Fig. 1. General view of the surface, twice natural size. The effect of the etching has been merely to develop a dull, fine frosting of the surface, as generally exhibited by ataxites. Note that some trace is still visible of fine scratchings due to imperfect polishing.

Fig. 2. Magnification, 100 diams. A directional structure, though on a minute scale, is now visible.

Fig. 3. Magnification, 200 diams. The taenitic elements are seen to follow a definite octahedral arrangement.

Fig. 4. Magnification, 500 diams. The taenitic rods are seen to form an octahedral skeleton embedded in a directionless kamacitic nickel-iron alloy low in nickel content.

Plate II.

Fig. 1. Shows the surface appearance of the Arltunga meteorite. The discoverer, when testing his find with a sledge hammer, was responsible for the small flat spot on the left top edge of the picture. The mark of a boring tool, employed for further testing the nature of the discovery, is also visible near the top edge towards the centre of the

(3) "Meteorites," Farrington, p. 198.

(4) "On the Genetic Relationship and Classification of Meteorites," by G. T. Prior. Min. Mag., vol. xviii., No. 83, p. 26.

(5) *Vide* Lacroix, A.; Min. Abstracts, vol. v. (1932), No. 1, p. 11.

picture. The comparatively smooth surface and absence of deep corrosion pits is to be remarked. The reproduction is about three-sevenths natural size.

Fig. 2. Illustrates the appearance of portion of the outer skin of the Karoonda meteorite. The view includes the junction of a scoria-coated, smooth face and a deeply scored face. The former was evidently at the rear of the aerolite when in flight, the latter was a forward-facing side exposed to the rush of air when traversing the atmosphere. A patch in the right-hand top corner is a natural fracture surface. Magnification: x $^7/_6$.

PLATE III.

Fig. 1. Illustrates the appearance of a natural fracture-surface exhibited by a fragment of the Karoonda meteorite. Note chondri (marked by arrows) standing in relief above the general surface. Magnification: x $^3/_2$.

Fig. 2. The appearance of a microscope slide of the Karoonda meteorite viewed by transmitted light and magnified 15 diameters. Several chondri, composed of a coarser granular material, are to be observed set in a fine brecciated base of olivine, enstatite, troilite, etc.

NOTES ON FOSSILIFEROUS CAMBRIAN NEAR KULPARA SOUTH AUSTRALIA

BY T. A. BARNES, B.SC., AND A. W. KLEENMAN, B.SC.

Summary

The area under consideration in this paper is on the main Port Wakefield-Wallaroo road, about two miles east of Kulpara. The existence of Cambrian limestone in this area was reported by Professor Howchin in 1925.[1] Professor Howchin noted fragmentary trilobites in the limestones of this area. The present investigations were undertaken at the suggestion of Mr. A. K. M. Edwards, B.Sc., who had also noted trilobites in this vicinity. We are indebted to him for much help in our work in this area.

NOTES ON FOSSILIFEROUS CAMBRIAN NEAR KULPARA, SOUTH AUSTRALIA.

By T. A. Barnes, B.Sc., and A. W. Kleeman, B.Sc.

[Read November 9, 1933.]

The area under consideration in this paper is on the main Port Wakefield-Wallaroo road, about two miles east of Kulpara. The existence of Cambrian limestone in this area was reported by Professor Howchin in 1925.(1) Professor Howchin noted fragmentary trilobites in the limestones of this area. The present investigations were undertaken at the suggestion of Mr. A. K. M. Edwards, B.Sc., who had also noted trilobites in this vicinity. We are indebted to him for much help in our work in this area.

Physiographically the area is on the eastern fault scarp of the Yorke Peninsula Horst. Here the easterly flowing streams have cut into the deep soil of the old peneplain and have exposed the beds. The more rapid erosion has also stripped the cover of soil from the hillsides, and so outcrops are common.

The observed succession of beds is:—

(d) Shales with thin interbedded limestones.
Both shales and limestones contain fossils.

(c) Massive limestones unfossiliferous, 900 feet thick.

(b) Thick series of red and white flaggy quartzites of a variable nature, 900 feet thick.

(a) Purple slates.

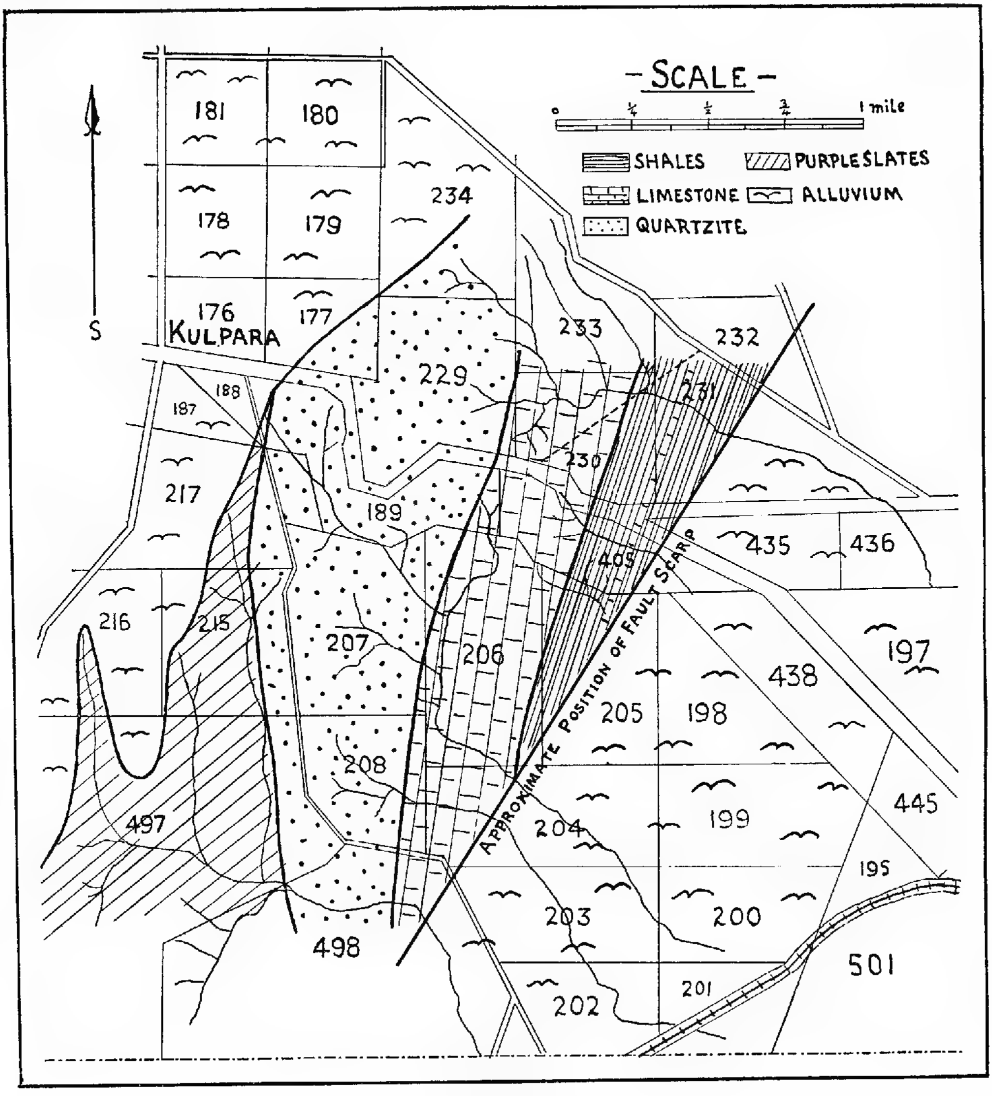
The fault scarp strikes N. 20° E., and the beds where they were examined on the edge of the peneplain on the west side of the fault strike N. 10° E. and have a general easterly dip. Thus the upper limit of the shales, in the area examined, is cut off by the fault. The lower limit of the quartzite is obscured by the deep soils of the old peneplain, with the exception of the southern end of the area, where a stream has cut into the beds exposing purple slates.

The massive limestone, which forms the strongest bed of the area, outcrops well in creek beds and on hill slopes, and can be traced both north and south from the main road. The western limit of the limestone, which crosses the road at junction of Sections 230 and 229 (Hd. of Kulpara), can be traced southward into Section 498, where it appears to be cut off by the fault. The eastern limit is lost in Section 206. The dip is fairly constant 25° to the east. The limestone is massive, blue to white in colour, and dolomitic. It is unfossiliferous except for some doubtful worm burrows.

The shales which overlie the massive limestone do not give good exposures, but occasional interbedded thin limestones shed boulders on hill slopes and outcrop in creeks. Trilobite remains are found in these thin limestones. There is a pipe track running in direction N. 56° E through Sections 230 and 231, which cuts both the shales and the massive limestones. It was amongst the shale fragments thrown up in the laying of this pipe track that the best fossils were found. It is probable that these shales have a well-preserved trilobite fauna at depth, but it was found impossible to get unweathered material.

(1) Howchin, W., The Geographical Distribution of Fossiliferous Rocks of Cambrian Age in South Australia, with Geological Notes and References, Trans. Roy. Soc. S. Austr., vol. xlix., pp.1-26, 1925.

The quartzites which underlie the limestones are variable in nature, being in the main red and white flaggy quartzites. As one passes westward along the road the dip becomes less, until in Section 189 the dip is 10° to the east. In Section 498, in the southern portion of the area, a creek running west to east gives a good section exposing the quartzites resting conformably on purple slates. The quartzites are about 900 feet thick.



LOCALITY PLAN.

The purple slates underlie the quartzites in Section 498, dipping at 20° to the east. They extend westerly into Section 497, where they become contorted with the formation of asymmetric folds. There was no unconformity observed between the slates and the overlying quartzites.

These slates are the oldest beds observed, and time did not permit us to follow the sequence westward or southward.

A feature of the area is the formation of limonite at the junction of the quartzites and the limestones. The quartzite immediately below the limestone is much ferruginised.

The trilobite remains found were submitted to Mr. F. Chapman, F.L.S., etc., Commonwealth Palaeontologist, who kindly supplied the following note:—"They seem to represent a Middle Cambrian facies and are all referable to two species of the genus *Ptychoparia*. The species with the smaller cephalon bears a close resemblance to Woodward's *Dolichometopus tatei,* but as the original type specimen is very imperfect there is a doubt about it and it may be a new species. The other species is related to *Ptychoparia howchini,* but as the apex of the glabella in your specimen is much more pointed, this also is probably new."

Careful search was made for Archaeocyathinae, but none could be found. It is probable that the Archaeocyathinae did not relish the muddy and sandy conditions indicated by the associated beds.

The fossiliferous shales thus studied are, on the above evidence, probably of Middle Cambrian Age. They are underlain by 900 feet of limestone and 900 feet of quartzites. The quartzites might prove to be fossiliferous if carefully searched. The quartzites pass down into purple slates of unknown age. Detailed work would be necessary to clear up the relation of these beds to the Adelaide Series.

THE COMPOSITION OF SOME IRONSTONE GRAVELS FROM AUSTRALIAN SOILS

BY J. A. PRESCOTT, WAITE INSTITUTE, GLEN OSMOND

Summary

A feature of many soils associated with uplifted peneplains in Australia is the presence of ironstone gravels, which in most cases are attributed [Prescott, Ref. 5] to former periods of wetter soil conditions when water-logging and shallow water tables were more common than is at present the case. These gravels are usually concretionary in character, and are further frequently found in association with ironstone "duricrust" laterite cappings. A number of gravels separated from soil samples collected in Western Australia and South Australia have been examined with a view to determining their general character and the amount of free iron and aluminium oxides present.

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By J. A. Prescott, Waite Institute, Glen Osmond.

[Read April 12, 1934.]

A feature of many soils associated with uplifted peneplains in Australia is the presence of ironstone gravels, which in most cases are attributed [Prescott, Ref. 5] to former periods of wetter soil conditions when water-logging and shallow water tables were more common than is at present the case. These gravels are usually concretionary in character, and are further frequently found in association with ironstone "duricrusts" or laterite cappings. A number of gravels separated from soil samples collected in Western Australia and South Australia have been examined with a view to determining their general character and the amount of free iron and aluminium oxides present.

Of the methods available for the examination, three appeared to present useful possibilities—one, the extraction with boiling hydrochloric acid as employed in soil analysis; the second, the extraction with a mixture of the three strong acids as recently standardised by Groves (Ref. 2); and the third, the extraction with boiling oxalic acid which was known to dissolve iron oxide from soils, but the action of which on the other constituents of the ironstone gravels was unknown. In addition, there was the possibility of employing the method of alizarin adsorption as used by Hardy (Ref. 3), in order to detect free alumina, if this were present.

As free iron oxide is one of the important mobile components of the soil profile, some method for its separate estimation would be of value, but it is evident that the most promising method, that of extraction with oxalic acid, accounts for more than the free oxide, and has some decomposing action on the clay of the soil.

The concretionary character of the gravels implies that they will contain material from the soil in which they have been developed, and that this is indeed the case is indicated from an inspection of the data in Tables I. and II.

The samples examined were selected from materials collected during the course of exploration and survey, and forming part of the Waite Institute soil collection. Their origin is given below:—

No. 2,306. Collected by Mr. Michael Terry from Gibson's Desert, 178 miles from Hazlett's well in the Warburton Ranges on the way to Laverton. The sample represents the material larger than 2 mm. separated from soil samples taken from the surface to a depth of 26 inches from a gravelly undulation.

No. 2,310. Collected by Mr. Michael Terry from Gibson's Desert, 80 miles from Hazlett's well. The sample represents the material larger than 2 mm. separated from soil samples to a depth of 27 inches from a gravelly flat.

No. 2,296. Collected by Mr. Michael Terry from Gibson's Desert, 79 miles from Hazlett's well. The gravel is separated from a soil sample six inches in depth.

No. 2,954. Collected by Mr. Michael Terry from the vicinity of the Warburton Ranges. The gravel is separated from soil samples to a depth of 28 inches. 20% of the original gravel consisted of quartz.

———— Single hollow concretion collected from the surface of the sand plain near Mingenew, W. Aust., by the author.

———— Ironstone capping from the flat summit of King's Table Hill, northeast of Geraldton, W. Aust., collected by the author.

———— Capping from the summit of a "rise" near Goomalling, W. Aust., collected by the author.

No. 3,068. Collected by Mr. J. S. Hosking at Gingin, W. Aust., from soil horizons down to 24 inches.

No. 3,021. Collected by Mr. J. S. Hosking at Gingin from red-brown sands associated with the upper and lower greensands. Gravel is separated from soil horizons down to 80 inches. Original contained 55% of quartz gravel.

No. 2,995. Collected by Mr. J. S. Hosking at Walpole, W. Aust., in typical karri and tingle country, from soil horizons down to 48 inches. Original contained 10% of quartz gravel.

No. 2,694. Collected by Dr. E. J. Underwood at Denmark, W. Aust., in karri country, from the top 22 inches of soil. Original contained 53% of quartz.

———— Single pieces of ironstone collected from the surface of the soil by the author at Alawoona, S. Aust.

No. 2,962. Ironstone gravel collected from the surface of the soil by the author in sandy scrub country at Waitpinga, S. Aust.

No. 1,850. Collected by the author; gravel separated from the top 27 inches of soil in the Hundred of Kuitpo, Section 279. 51% of the original gravel consisted of non-ironstone material, mainly mica-schist.

No. 1,961. Collected by Mr. R. J. Best at Birdwood, S. Aust. Gravel separated from soil horizon 9 to 14 inches, and of which 32% consisted of quartz.

No. 2,481. Collected by Mr. J. S. Hosking at Hawk's Nest, Kangaroo Island. Gravel separated from surface 13 inches of soil. 3% consisted of quartz and sandstone.

No. 2,485. Collected by Mr. J. S. Hosking at Hawk's Nest, Kangaroo Island. Gravel separated from surface 18 inches of soil. 3% consisted of quartz and sandstone.

The gravels were hand-picked to remove quartz or other material not typically ironstone in character, and then washed thoroughly by shaking with dilute ammonia to remove any adhering clay. After thorough washing with cold water the gravels were air-dried and ground to pass an 0·5 mm. sieve. For the alizarin adsorption test this material was further sub-sampled and ground to pass a 90-mesh sieve.

For the extraction with hydrochloric acid, digestion in the water bath for 48 hours, as employed in soil analysis, was adopted. In two cases only extraction with the tri-acid mixture and 5% oxalic acid was attempted. As the oxalic acid

extraction was not specific enough, it was not adopted for the remainder of the samples. A comparison of the results obtained by the three methods is given in Table I.

TABLE I.

	Insoluble ignited %	Fe_2O_3 %	Al_2O_3 %	TiO_2 %	SiO_2 %	Moisture %	Loss on ignition %	Total %
Goomalling:								
Tri-acid extraction -	0·0*	21·8	25·8	1·2	39·0	1·6	10·6	100·0
HCl extraction -	42·1	22·1	23·5	0·5	—	1·6	10·6	100·4
Oxalic acid extraction	51·2	20·9	7·0	—	—	1·6	10·6	91·3
Denmark (2694):								
Tri acid extraction -	4·4*	52·1	12·9	0·8	22·2	2·8	5·3	100·5
HCl extraction -	26·8	51·8	12·7	0·5	—	2·8	5·3	99·9
Oxalic acid extraction	32·1	47·8	9·0	—	—	2·8	5·3	97·0

* After treatment with HF.

The oxalic acid extraction was carried out by digestion on the water bath overnight. The residue was greyish-white in colour, all free iron oxide having presumably been extracted. The oxalic acid extract was observed to contain silica.

The adsorption by alizarin followed the technique of Hardy, one gramme of the finely divided material being treated first with an 0·5% solution of alizarin–S in 80% alcohol saturated with boracic acid, and after careful washing extracted with saturated sodium oxalate-oxalic acid solution (8·8 gm. oxalic acid + 16·2 gm. sodium oxalate per litre). There is no great regularity in the results, the weighted mean of the adsorption values for the fresh material corresponding to 4·94 mgm. of alizarin–S per gramme of Fe_2O_3, Hardy and Follett-Smith's value for limonite being 1·28 mgm. per gm. The adsorption of the ignited material was expected to throw some light on the presence or absence of free alumina in these ironstones. Hardy's figures for the adsorption of alizarin by ignited Gibbsite correspond to 23·6 mgm. per gm. of Al_2O_3, which would suggest that free alumina may actually be present to the extent of 1% or 2% in most of the samples.

The results of the analyses of the hydrochloric acid extracts and of the alizarin adsorption tests are given in Table II. The quantities of Fe_2O_3 extracted vary from 22 % to 74%. Probably the most interesting feature is the very low amount of manganese present in these gravels. This is in marked contrast to conditions in the red loams of Queensland, where it has been shown by Best (Ref. 1) that concretions may contain up to 10% of Mn.

REFERENCES.

1. BEST, R. J. "J. Agric. Sci.," **vol. xxi.**, p. 337. 1931.
2. GROVES, RUBY C. "J. Agric. Sci.," **vol. xxiii.**, p. 519. 1933.
3. HARDY, F. "J. Agric. Sci.," **vol. xxi.**, p. 150. 1931.
4. HARDY, F., and FOLLETT-SMITH, R. R. "J. Agric. Sci.," **vol. xxi.**, p. 739. 1931.
5. PRESCOTT, J. A. "Coun. Sci. Ind. Res." Bull. lii. 1931.

TABLE II.

Sample Number	Locality	Depth in Inches.	Moisture	Loss on Ignition	Extracted by Digestion with Hydrochloric Acid: Ignited Residue	Extracted by Digestion with Hydrochloric Acid: Fe_2O_3	Extracted by Digestion with Hydrochloric Acid: Al_2O_3	Extracted by Digestion with Hydrochloric Acid: TiO_2	Extracted by Digestion with Hydrochloric Acid: Mn_3O_4	Extracted by Digestion with Hydrochloric Acid: Total	Alizarin Adsorption mgm. per gm.: Fresh	Alizarin Adsorption mgm. per gm.: Ignited	Alizarin Adsorption mgm. per gm.: Fresh per gm. Fe_2O_3
			%	%	%	%	%	%	%	%			
	WESTERN AUSTRALIA:												
2306	Gibson's Desert	0–26	0·7	8·7	52·6	30·8	6·8	0·2	0·00	99·8	2·17	0·37	7·02
2310	Gibson's Desert	0–27	0·8	6·0	38·5	49·0	5·5	0·3	0·07	100·2	2·61	0·72	5·32
2296	Gibson's Desert	0–6	0·9	10·0	40·3	42·8	5·6	0·3	0·01	99·9	1·69	1·13	3·96
2954	Warburton Range	0–28	1·2	4·6	23·7	66·0	4·1	0·8	0·03	100·4	4·09	0·38	6·20
—	Mingenew	surface	0·9	3·1	54·3	39·8	2·8	0·3	0·01	101·2	0·00	0·27	0·00
—	King's Table Hill	capping	0·7	3·7	19·5	74·3	3·6	0·0	0·05	101·8	2·72	0·00	3·66
—	Goomalling	capping	1·6	10·6	42·1	22·1	23·5	0·5	0·01	100·4	3·77	2·67	17·10
3068	Gingin	0–24	2·0	7·6	42·6	37·8	9·9	0·2	0·00	100·1	2·51	1·48	6·63
3021	Gingin	0–80	1·5	4·7	29·0	54·0	9·5	0·2	0·00	98·7	5·03	1·28	9·32
2995	Walpole	0–48	2·8	8·9	29·9	42·8	14·9	0·2	0·00	99·5	3·46	1·74	8·08
2694	Denmark	0–22	2·8	5·3	26·8	51·8	12·7	0·5	0·02	99·9	3·24	0·28	6·27
	SOUTH AUSTRALIA:												
—	Alawoona	surface	0·4	6·6	54·5	34·7	2·0	0·1	0·00	100·2*	0·58	3·38	1·67
2962	Waitpinga	surface	0·6	1·7	47·7	44·9	4·3	0·4	0·02	99·6	0·86	0·25	1·91
1850	Kuitpo	0–27	1·7	3·4	32·7	54·0	8·1	0·2	0·00	100·1	1·79	0·82	3·32
1961	Birdwood	9–14	0·7	2·6	29·4	57·6	8·6	0·4	0·01	99·3	1·32	0·73	2·29
2481	Kangaroo Island	0–13	1·2	1·7	49·8	41·0	6·7	0·3	0·01	100·7	1·17	0·36	2·86
2485	Kangaroo Island	0–18	1·3	2·1	37·3	50·0	9·2	0·3	0·02	100·2	2·35	0·75	4·70
											Weighted Mean		4·94

* Includes 1·4% CaO and 0·3% MgO. Material washed with 2NHCl prior to alizarin adsorption.

KINSHIP AND DESCENT AMONG THE AUSTRALIAN ABORIGINES.

BY H. K. FRY, D.S.O., M.B., B.S., B.SC., D.P.H., DIPL.ANTH.

Summary

A line drawn from the Albert River in the Gulf of Carpentaria to Fowler's Bay on the Great Australian Bight approximately represents the former division of Australia into an eastern matrilineal and a western patrilineal area.

KINSHIP AND DESCENT AMONG THE AUSTRALIAN ABORIGINES.

By H. K. Fry, D.S.O., M.B., B.S., B.Sc., D.P.H., Dipl.Anth.

[Read April 12, 1934.]

A line drawn from the Albert River in the Gulf of Carpentaria to Fowler's Bay on the Great Australian Bight approximately represents the former division of Australia into an eastern matrilineal and a western patrilineal area.

The eastern and western peoples, however, were not homogeneous in regard to descent. Patrilineal societies existed at the Murray Mouth, in the Melbourne district, on the coast of New South Wales and the adjacent portion of Victoria, and in Queensland near Maryborough and in a part of Cape York Peninsula.

Matrilineal societies existed in the western area in the district about Perth, and still exist in the Coburg Peninsula and in Melville and Bathurst Island. W. E. H. Stanner (Ref. 22, pp. 398-400) has described the Nangiomeri tribe of the Daly River as a patrilineal people in the process of transition to a matrilineal class and totem system. The new regime is considered to have spread from the Eastern Kimberley or Hall's Creek district. The social system which has resulted is similar to that of Eastern Arnhem Land (Ref. 23, pp. 416, 417), so that the latter society also may be interpreted as a mingling of patrilineal and matrilineal institutions. The tribes of the Victoria River have patrilineal classes but matrilineal totems. All the tribes of north-western Western Australia and the northern part of the Northern Territory have patrilineal class systems, but these are also matrilineal in that the children of irregular marriages take the class determined by that of the mother, not the father. Children of irregular marriages in Central Australia follow the father.

Therefore it would appear that an increasingly marked matrilineal influence is manifested in this western area as the coast is approached.

The eastern area presents the converse condition. But the patrilineal societies of the coastal regions of the eastern area, and also of the southern zone near the coast of the western area, are of a different type to the societies which make up the great part of the western patrilineal area. The former are organised in local groups or moieties named, like the matrilineal classes, after animals. The classes of the latter societies have names which suggest an origin from kinship terms. An illustration of the manner in which such terms could become class names is given by Howitt (Ref. 15, p. 230). Also the initiatory rites of the former societies usually conform to those typical of the matrilineal area.

The Kinship Systems of Paternal and Maternal Societies.

The usual pattern of social organisation of both patrilineal and matrilineal societies in Australia can be represented (Ref. 10, p. 16; Ref. 11, pp. 29, 34; Ref. 12, p. 271) [1] diagrammatically as shown in Table I.:—

(1) I have found that unilateral cross-cousin marriage can be expressed by a system of three clans, a1, b1, and c1. The type marriages and kinship patterns in this case are homologous with those given (Ref. 11, p. 30) for four or more clans. These patterns represent the intermarriage of six kinship groups or classes. They permit the marriage of second cousins, but as they also allow marriage with father's sister's daughter or mother's brother's daughter, six kinship groups do not express partially the Aranda norm as stated (Ref. 12, p. 271). The conclusion that at least eight marriage divisions are necessary for the expression of the Aranda norm of kinship marriage rule, therefore, is more definite than was stated previously.

TABLE I.

1.	a1	A1	b1	B1	a2	A2	b2	B2
2.	a1	B1	b1	A1	a2	B2	b2	A2
1.	a1	A2	b1	B2	a2	A1	b2	B1
2.	a1	B2	b1	A2	a2	B1	b2	A1
1.	a1	A1	b1	B1	a2	A2	b2	B2

The table represents the genealogical relationships of eight marriage divisions (classes or kinship groups). Each horizontal line represents a generation. The numbers at the beginning of each line apply to all the terms of that line, so that the eight marriage divisions are expressed by the eight terms, 1a1, 1b1, 1a2, 1b2, 2a1, 2b1, 2a2, and 2b2. Corresponding terms in small case letters and capitals, such as 1a1 and 1A1, represent individuals of opposite sexes who are members of one division. Members of "a" divisions and "b" divisions intermarry. The vertical columns of the table represent lines of male and female descent, so that "son" in one line is directly under "father" in the line above, and "daughter" under "mother." For example, 2a1 and 2A1 are the children of 1a1 and 1B1; 2b1 and 2B1 are the children of 1b1 and 1A1; 1a1 and 1A1 are the children of 2a1 and 2b2. The children take the denomination of the father in a patrilineal society, so the terms in small case letters represent males and those in capitals represent females when the table is used to illustrate a patrilineal system. Conversely the letters in small case represent females and the terms in capitals represent males when the diagram is applied to the conditions of a matrilineal society.

Table I. can be used as a chart upon which relationship terms can be plotted.

The kinship terms used by an Australian native and his sister are identical in regard to individuals who have the status of actual kindred. For example, a man and his sister usually use the same terms for individuals who have the status of parents or relatives of parents. Similarly, a man's sons and daughters and their children are referred to by the man's sister in the same terms that he uses, and a woman's sons and daughters and their children are designated by her brother by the same terms which she uses. But individuals of the same or of the two contiguous generations who have the status of affinities, *i.e.*, relatives by marriage, usually are addressed by different terms by a man and his sister, so that the pattern of kinship terminology is not quite the same when *Ego* is represented alternatively by a man and his sister.

The pattern of Table I. obviously is not symmetrical in regard to male and female representatives of marriage divisions, one vertical column representing a cycle of two generations, the other a cycle of four generations. Therefore the pattern which appears when the kinship terminology of a matrilineal society is plotted upon Table I., will be different from the pattern which illustrates the terminology of a patrilineal organisation.

Four different patterns of genealogical relationships can be plotted on the table, therefore, corresponding to the varying circumstances that *Ego* may be a male or a female, and that descent may be matrilineal or patrilineal.

These four patterns are illustrated in Table II.

The form of Table II. is that of Table I. Under each of the symbols representing the marriage divisions the four variations of genealogical relationship are indicated. *Ego* is represented alternatively by the brother and sister symbols 1a1 and 1A1 in the third generation. Genealogical relationships are charted under each of the symbols corresponding to those of Table I. in the following order:—

(i.) Relationships where *Ego* is 1a1, a male, in a patrilineal system.
(ii.) Relationships where *Ego* is 1A1, a female, in a patrilineal system.
(iii.) Relationships where *Ego* is 1A1, a male, in a matrilineal system.
(iv.) Relationships where *Ego* is 1a1, a female, in a matrilineal system.

It will be seen that the relationships of line (i.) are the exact converse in sex terms to those of line (iv.), and the relationships of line (iii.) the converse of those of line (ii.).

Native kinship terms usually are not so numerous as the genealogical relationships of Table II., as the same term is often applied to members of the same marriage division which reappears in alternate generations.

In the following discussion male-speaking kinship terms only will be considered, and the comparison of the matrilineal and patrilineal patterns will be confined to the relationships represented in lines (i.) and (iii.).

Cross-cousins in both matrilineal and patrilineal systems will be seen to be associated with the kinship divisions 1b2 and 1B2 in Table II. But the same kinship divisions, 1b2 and 1B2, in the second ascending generation are associated with the relationships of mother's father and his sister in a patrilineal system, and with the relationships of father's mother and her brother in a matrilineal system.

Similarly the same kinship divisions, 1b2 and 1B2, in the second descending generation are associated with the relationships of daughter's son and daughter in a patrilineal system, but with the relationships of sister's son's daughter and son in a matrilineal system.

Both mother's mother's brother and his son's son in a patrilineal system will be seen to be associated with the kinship group 1a2 in Table II. On the other hand, in a matrilineal system, mother's mother's brother is 1A1 and his son's son is 1A2, so these individuals respectively belong to different divisions.

Professor Elkin, in discussing the matrilineal Dieri system (Ref. 6, pp. 495-6), has pointed out that the Dieri use one term for cross-cousin and father's mother, but that many tribes of the Aranda type use one term for cross-cousin and for wife of mother's mother's brother [mother's father's sister in Table II., line (i.)]; also that the Aranda use one term for mother's mother's brother and his son's son, but that the Dieri do not.

The Aranda is a patrilineal system, and it is evident that these contrasting features of kinship terminology are the direct and natural outcome of the contrasting relationship patterns of matrilineal and patrilineal societies.

Reference to Table II. will show that in a patrilineal system 1B1, wife, corresponds in the second descending generation with 1B1, sister's son's daughter. Marriage with the latter woman is a well-recognised rule in the patrilineal area of North-Western Australia. (Ref. 8, p. 308). I have been able to find only one instance in published works where the same term is applied to wife and sister's son's daughter (Ref. 1, p. 182), but many should appear when full terminologies of the north-western tribes are published. Another example has been discovered personally in the Pintubi tribe in Central Australia. The general possibility of this form of marriage in patrilineal societies is indicated by the fact that in patrilineal tribes it is the rule to use one term for both wife's mother and sister's son's wife (2A2, in Table II).

On the other hand, in a matrilineal society, the pattern of Table II. demonstrates that 1b1, wife, corresponds in the second descending generation with 1b1, daughter's daughter, while sister's son's daughter is 1b2. The Dieri term for the two former relationships is *nadada,* that for the last is *kami.* Howitt (Ref. 15, p. 164) has described marriage with the brother's daughter's daughter in the matrilineal Dieri people. Dr. Elkin has challenged this observation (Ref. 6, p. 196), but his argument is not convincing. The general possibility of this form of marriage in matrilineal societies is indicated by the use in matrilineal tribes of one term for both wife's father and daughter's husband (2A2, in Table II.), *e.g.,* Dieri *taru* (Ref. 15, p. 160; Ref. 6, p. 197); Chaap wuurong *nitchang*

TABLE II.

		1.	**a1**	**A1**	**b1**	**B1**	**a2**	**A2**	**b2**	**B2**
	♂. Patl.	(i.)	f.f.	f.f.s.	f.m.b.	f.m.	m.m.b.	m.m.	m.f.	m.f.s.
	♀. „	(ii.)	f.f.	f.f.s.	f.m.b.	f.m.	m.m.b.	m.m.	m.f.	m.f.s.
	♂. Matl.	(iii.)	m.m.	m.m.b.	m.f.s.	m.f.	f.f.s.	f.f.	f.m.	f.m.b.
	♀. „	(iv.)	m.m.	m.m.b.	m.f.s.	m.f.	f.f.s.	f.f.	f.m.	f.m.b.
		2.	**a1**	**B1**	**b1**	**A1**	**a2**	**B2**	**b2**	**A2**
	♂. Patl.	(i.)	f.	w.f.s.	w.f.	f.s.	w.m.b.	m.	m.b.	w.m.
	♀. „	(ii.)	f.	h.f.s.	h.f.	f.s.	h.m.b.	m.	m.b.	h.m.
	♂. Matl.	(iii.)	m.	w.m.b.	w.m.	m.b.	w.f.s.	f.	f.s.	w.f.
	♀. „	(iv.)	m.	h.m.b.	h.m.	m.b.	h.f.s.	f.	f.s.	h.f.
		1.	**a1**	**A2**	**b1**	**B2**	**a2**	**A1**	**b2**	**B1**
Ego a1	♂. Patl.	(i.)	b.	f.f.s.d.d.	w.b./s.h.	f.s.d./m.b.d.	m.m.b.*s.s.*	s.	m.b.*s.*/f.s.*s.*	w.
Ego A1	♀. „	(ii.)	b.	f.f.s.d.d.	h.	f.s.d./m.b.d.	m.m.b.*s.s.*	s.	m.b.*s.*/f.s.*s.*	h.s./b.w.
Ego A1	♂. Matl.	(iii.)	s.	m.m.b.*s.s.*	w.	m.b.*s.*/f.s.*s.*	f.f.s.d.d.	b.	f.s.d./m.b.d.	w.b./s.h.
Ego a1	♀. „	(iv.)	s.	m.m.b.*s.s.*	h.s./b.w.	m.b.*s.*/f.s.*s.*	f.f.s.d.d.	b.	f.s.d./m.b.d.	h.
		2.	**a1**	**B2**	**b1**	**A2**	**a2**	**B1**	**b2**	**A1**
	♂. Patl.	(i.)	*s.*	*s.*w.	s.*s.*	s.*s.*w.	s.d.h.	s.d.	d.h.	d.
	♀. „	(ii.)	b.*s.*	b.*s.*w.	*s.*	*s.*w.	d.h.	d.	b.d.h.	b.d.
	♂. Matl.	(iii.)	s.d.	s.d.h.	d.	d.h.	*s.*w.	*s.*	s.*s.*w.	s.*s.*
	♀. „	(iv.)	d.	d.h.	b.d.	b.d.h.	b.*s.*w.	b.*s.*	*s.*w.	*s.*
		1.	**a1**	**A1**	**b1**	**B1**	**a2**	**A2**	**b2**	**B2**
	♂. Patl.	(i.)	*s.s.*	*s.*d.	s.*s.s.*	s.*s.*d.	s.d.*s.*	s.d.d.	d.*s.*	d.d.
	♀. „	(ii.)	b.*s.s.*	b.*s.*d.	*s.s.*	*s.*d.	d.*s.*	d.d.	b.d.*s.*	b.d.d.
	♂. Matl.	(iii.)	s.d.d.	s.d.*s.*	d.d.	d.*s.*	*s.*d.	*s.s.*	s.*s.*d.	s.*s.s.*
	♀. „	(iv.)	d.d.	d.*s.*	b.d.d.	b.d.*s.*	b.*s.*d.	b.*s.s.*	*s.*d.	*s.s.*

Explanation . . .... f. = father b. = brother *s.* = son h. = husband
m. = mother s. = sister d. = daughter w. = wife

niitch; Kuurn kopan *naluungar* (Ref. 5, pp. lxvi., lxvii., lxxiii., lxxiv.); Maroura *yundawa* (Ref. 25, p. 167).

Professor Rivers has brought out the evidence for marriage with the daughter's daughter or grandmother in Melanesia. He has deduced mechanisms by which such marriages could have originated. Sir George Grey (Ref. 13, vol. ii., p. 230) and W. A. Cawthorne (Ref 4, p. 76), speaking of the Perth and Adelaide tribes respectively, have stated that old men exchanged their daughters in marriage. This would mean that each man would marry his daughter's husband's daughter, that is, his classificatory daughter's daughter.

Daughter's husband in Australian patrilineal tribes is designated normally by the same term as is mother's brother. These relations are associated in each case with the kinship division 2b2 in Table II., line (i.).

Sister's son's wife in the matrilineal pattern corresponds to father's sister [both 2b2 in Table II. line (iii.)], and both may be termed *papa* in the Dieri tribe (Ref. 6, p. 496).

Therefore the evidence derived from genealogical relationship pattern, kinship terminology, and observed marriage customs, is in favour of the generalization that the normal marriage in Australia with a woman of the second descending generation is with a sister's son's daughter in patrilineal societies, and with the classificatory daughter's daughter in matrilineal societies.

Professor Radcliffe Brown (Ref. 1, p. 192) attempted to differentiate a variety (a) of Type II system by virtue of the distinction that in these tribes marriage with a relative corresponding to sister's son's daughter was permitted. This form of marriage is permissible in some tribes classified as Type I., so the original distinction has not been confirmed. It has been shown, however, in the last paragraph, that the contrasting kinship systems of matrilineal and patrilineal societies exhibit the differentiation which was suggested.

These differences of kinship terminology are not reflected in the method of disposal of a woman in marriage in matrilineal and patrilineal societies in Australia.

The father, usually associated with the nearest male relative, is described as disposing of his daughter in matrilineal tribes by Grey and Cawthorne, *loc cit.:* Taplin, Ref. 26, p. 10; Meyer, *ibid,* p. 190; Schuermann, *ibid,* p. 222; Taplin *et alii,* Ref. 25, pp. 30, 35, 50; Brough Smyth, Ref. 18, p. 77; Fraser, Ref. 9, p. 27; and by Howitt, Ref. 15, pp. 185, 193, 198, 205, 210, 227, 241, 245, 251, 267; and in patrilineal tribes by Spencer and Gillen: Ref. 19, p. 558; Ref. 20, p. 77; by Howitt, Ref. 15, pp. 232, 236, 254, 255, 257, 260, 263; Strehlow, Ref. 24, p. 89; and Radcliffe Brown, Ref. 1, p. 156.

The mother or mother's brother is stated to be the person responsible in matrilineal societies by Howitt (Ref. 15, pp. 177, 178, 195, 217, 222) and Roth (Ref. 17, p. 181); in patrilineal societies by Spencer and Gillen (Ref. 20, p. 603, *cf.,* pp. 77, 114); Radcliffe Brown (Ref. 1, p. 185; Ref. 3, p. 336); and Elkin (Ref. 8, p. 309). Howitt also states that the mother's brother punishes an erring sister's daughter (Ref. 15, p. 232). Spencer (Ref. 21, p. 51) states that in the Kakadu tribe the father arranges a normal marriage and the mother's brother the marriage with the step son.

Is there a Kinship System Intermediate between those of Matrilineal and Patrilineal Societies.

The kinship terminology of both matrilineal and patrilineal Australian tribes represents bilateral descent in that a husband and his wife, in common with their respective brothers and sisters, apply different kinship terms to members of the descending generations.

But matrilineal and patrilineal tribes each have their distinctive pattern of kinship terminology, as has been demonstrated. Should such tribes merge on

an equal footing, reference to Table II. will show that a conformable kinship terminology could result only by a merging of kinship terminology which may be represented diagrammatically by superimposing the two lateral halves of Table II. This manoeuvre would convert the eight-class form of the diagram into the form of a four-class diagram *(cf.* Fry, Ref. 10, pp. 16, 17), which would be conformable to a simpler kinship terminology in which first cousins would not be distinguished from second cousins.

No tribal system has been described which conforms completely in kinship terminology to this ideal four-class system. The Urabunna and Kariera are partial representatives. It is noteworthy that the former tribe lies on the matrilineal side of the borderline between the matrilineal and patrilineal areas. The Kariera is far within the patrilineal zone, but is situated peripherally on the coast where there are traces of matrilineal survivals, as has been discussed in the introduction to this paper.

A plausible explanation of the appearance of such systems is that they represent a compromise between the social organisation of matrilineal and patrilineal tribes. An alternative explanation has been proposed by A. W. Howitt and Professor Radcliffe Brown.

Howitt (Ref. 15, p. 189) advanced the idea that the Urabunna system represented a marriage rule permitting marriage with the father's sister's or mother's brother's daughter, and contrasted this with the marriage rule of the Dieri prescribing marriage with the mother's mother's brother's daughter's daughter, or mother's father's sister's daughter's daughter. Both of these tribes are matrilineal. Howitt considered that the Dieri rule is a development of that of the Urabunna, although he had suggested immediately before that the Urabunna rule in regard to totems was later than that of the Dieri. Radcliffe Brown formulated similar views in regard to Australian marriage rules, but found the Urabunna system unsatisfactory. He claimed to have found a more satisfactory example in the patrilineal Kariera tribe. The Kariera system, as Type I., was contrasted with the patrilineal Aranda system, which was termed Type II. (Ref. 1, pp. 190, *et. seq.).* The term "norm" has been substituted for that of Type (Ref. 3, p. 46, footnote). Professor Radcliffe Brown considers that the Aranda norm of kinship system is not derived historically from the Kariera norm, but that the Kariera and Aranda systems are two terms in an evolutionary process (Ref. 3, p. 452).

With regard to these type tribes, Dr. Elkin has confirmed Professor Radcliffe Brown's objection to the Urabunna, as he has found that the kinship system of this tribe approximates to that of the Dieri, and that the marriage rule is that of marriage with a distant second cousin (Ref. 3, pp. 56, 57). This author also states that the neighbouring Parnkala and Wailpi tribes are of the Kariera type, but does not give any detailed terminology. But the Kariera tribe is not as complete an example of the ideal type as Professor Radcliffe Brown has supposed. He has given only two male-speaking relationship terms for members of the second descending generation, namely, *maeli* and *tami,* for children of son and daughter respectively. He has given, however, the two female-speaking terms, *kabali* and *kandari* (Ref. 1, p. 153), for the children of a woman's son and daughter, respectively. This means that the Kariera terminology conforms exactly to that of the Aranda system in so far as the second descending generation is concerned.

Professor Elkin has published kinship terms of the patrilineal tribes of the Kimberley area to the north of the Kariera (Ref. 8, p. 296). The kinship terminologies of all these tribes, except the Ungarinyin, approximate to that of an ideal four-class system, but none is a complete example. The same applies to the

kinship terms given by Spencer (Ref. 21, p. 65, *et. seq.)* for the tribes of the Darwin area.

The Mungarai and Nullakun tribes of the Roper River have a predominantly patrilineal terminology, but use one term for wife's father and daughter's husband (Ref. 21 pp. 76, 78). Adequate information regarding the kinship systems of the tribes of the eastern matrilineal area of Australia is woefully lacking. But two examples of mixed terminology have been found.

The Yaralde was a tribe organised in patrilineal totemic clans. Marriages were carried out regularly with women of the surrounding tribes with matrilineal class systems. The terminology of the Yaralde (Ref. 2, pp. 232-237) is predominantly patrilineal, but one term, *yulundi,* was applied to wife's father and daughter's husband. The patrilineal Kurnai tribe also used one term, *ngaribil,* for these two relations by marriage (Ref. 14, p. 237; Ref. 15, p. 169).

All the examples given above occur in areas where matrilineal and patrilineal systems have, or may have, come in contact, and therefore these examples support the hypothesis that these kinship systems represent different degrees of compromise between matrilineal and patrilineal systems.

Evidence against this interpretation of the origin of such systems is that coastal tribes such as the Mara and Anula have a kinship system which is apparently entirely patrilineal (Ref. 20, pp. 87, 88); the same is true of the Waduman tribe with patrilineal classes and matrilineal totems (Ref. 21, p. 81). Conversely the Melville Island tribe, although apparently isolated, has a kinship system which approximates to the four-class type (Ref. 21, p. 71).

On the other hand, the outstanding objection to the alternative interpretation that the simpler kinship systems are the result of a marriage rule allowing marriage with first cousins is that this rule is not a valid one in fact. Marriage with an actual first cousin is exceptional in tribes of the "Kariera" type, and marriage with a distant cross-cousin is usual. Obviously a distant cross-cousin is at least a second cousin, which is the typical marriage-relation under the "Aranda" rule. Also, in tribes of the "Aranda" type, marriage with a first cousin is permitted under exceptional circumstances. Professor Radcliffe Brown has recognised this lack of differentiation between the two systems which he formerly termed types, as he states that "in spite of the diversity of the various systems, a careful comparison reveals them as being variations of a single type" (Ref. 3, p. 455).

Howitt and Radcliffe Brown have differentiated the apparently simpler organisations of the Urabunna and Kariera tribes from the Dieri and Aranda systems in order to present the former as more primitive evolutionary types than the latter. This opinion is questionable, as it is quite probable that the Aranda and Dieri systems are "primitive." The usual marriage rule in kinship terms throughout Australia is the prohibition of marriage between kindred nearer than cross-cousins who are distant in regard to consanguinity and locality. Family groups in Australia have territorial limits. Marriage with a distant kin not only minimises the danger of infringing the *tabu* on parents-in-law, but also gives a certain right of entry to other districts in addition to that of the mother. These considerations could operate from the very early times of the occupation of Australia, and the emphasis on "distant" cross-cousin marriage could be as primitive as the recognition of proprietary rights over a certain district by a family group. Such emphasis would entail the distinction from early times of wife's mother and her brother from father's sister and father, and of wife's father and his sister from mother's brother and mother. Children of these four varieties of kin would present varying degrees of marriageability, and the kinship groups would be defined territorially. Daughter's husband and his sister (son's wife) could be distinguished similarly from sister's children, and the spouses of sister's

children from sons and daughters. A kinship system growing up from this basis would be of the "Aranda" type, and would not pass through the stage of the "Kariera" type where wife's father and mother have the same kinship status as mother's brother and father's sister, and children's spouses have the kinship status of sister's children.

There is, therefore, both actual and theoretical support in favour of the suggestion that the existence of relatively simpler systems of kinship terminology and kinship marriage rule in certain tribes, of which the Kariera is the accepted type, is due to a compromise between matrilineal and patrilineal systems, rather than that the apparently simpler systems represent a prior type in an evolutionary sequence.

References.

1. Brown, Radcliffe A. R. 1913. Three tribes of Western Australia. J. of the R. Anth. Inst. **Vol. xliii., p. 143.**
2. ,, ,, ,, 1918. Notes on the Social Organisation of Australian Tribes. *Ibid.* **Vol. xlviii., p. 222.**
3. ,, ,, ,, 1930-31. The Social Organisation of Australian Tribes. Oceania. **Vol. i., pp. 34, 206, 322, 426.**
4. Cawthorne, W. A. 1844. Rough Notes on the Manners and Customs of the Natives. Proc. of the R. Geograph. Soc., S. Aust. Branch. 1925, p. 46.
5. Dawson, J. 1881. Australian Aborigines.
6. Elkin, A. P. 1931. The Dieri Kinship System. J. of the R. Anth. Inst. **Vol. lxi., p. 493.**
7. ,, ,, 1931. The Social Organisation of South Australian Tribes. Oceania. **Vol. ii., p. 44.**
8. ,, ,, 1932. Social Organisation in the Kimberley Division. Oceania. **Vol. ii., p. 296.**
9. Fraser, J. 1892. The Aborigines of New South Wales.
10. Fry, H. K. 1931. A Table Showing the Class Relations of the Aranda. Trans. of the Roy. Soc. of S. Aust. **Vol. lv., p. 12.**
11. ,, ,, 1932. Genealogical Studies of Australian Tribal Systems. *Ibid.* **Vol. lvi., p. 27.**
12. ,, ,, 1933. Australian Marriage Rules. The Sociological Review. **Vol. xxv., p. 258.**
13. Grey, G. 1841. Journals of Two Expeditions of Discovery.
14. Howitt, A. W., and Fison, L. 1880. Kamilaroi and Kurnai.
15. Howitt, A. W. 1904. The Native Tribes of South-East Australia.
16. Rivers, W. H. R. 1914. The History of Melanesian Society.
17. Roth, W. E. 1897. Ethnological Studies in N.W. Central Queensland.
18. Smyth, R. Brough. 1878. The Aborigines of Victoria.
19. Spencer, B., and Gillen, F. J. 1899. The Native Tribes of Central Australia.
20. ,, ,, ,, ,, ,, 1904. The Northern Tribes of Central Australia.
21. Spencer, B. 1914. Native Tribes of the Northern Territory of Australia.
22. Stanner, W. E. H. 1933. The Daly River Tribes. Oceania. **Vol. iii.,** p. 377.
23. ,, ,, 1933. A Note upon a Similar System Among the Nangiomeri. *Ibid.*, p. 416.
24. Strehlow, C. 1913. Die Aranda- und Loritja-Staemme. Th. iv., Abt. i.
25. Taplin, G., et *Alii.* 1879. South Australian Aboriginal Folk Lore.
26. Woods, J. D. 1879. Native Tribes of South Australia.

NOTES ON THE ABORIGINES OF THE SOUTH-EAST OF SOUTH AUSTRALIA.
PART I.

BY T. D. CAMPBELL, D.D.SC.

Summary

Little has been published concerning the life and habits of the aborigines who occupied that portion of South Australia lying south of the River Murray. Therefore the recording of any further information, however fragmentary, seems fully justified. The aim of the notes constituting Part I of this survey is to summarise briefly the available sources of recorded data on the aborigines of the South-East of this State, and, in addition, to place on record a few observations collected by the writer.

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By T. D. Campbell, D.D.Sc.

[Read May 10, 1934.]

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The aim of the notes constituting Part I of this survey is to summarise briefly the available sources of recorded data on the aborigines of the South-East of this State, and, in addition, to place on record a few observations collected by the writer.

Territory Defined.

As Fenner (1) has pointed out, the term "South-East" has become so thoroughly established that its usage might well be continued. The same writer describes this area as a distinct "natural region," and the description and boundaries which he gives to it have been adopted for present consideration. It is felt that by assuming an identity between the features which constitute the geographer's "natural region" and those which are present in the natives' "tribal beat," we may have a useful basis for considering the distribution of our aboriginal population. A closer appreciation and application of the above-mentioned authority's geographical studies on this State would surely help to clarify and add to the interest of research on its indigenous as well as its modern inhabitants. In other words, the geographical controls of rainfall, temperature, relief, and soils, dominated the existence of the earlier inhabitants just as they do those of the present time.

The "South-East," therefore, is the southernmost portion of the State, and its boundaries, as suggested by Fenner (Map. No. 130), are the coastline, the Interstate border, and an arbitrary "line" stretching with a slight southerly trend from Kingston to the Victorian border. He describes it as consisting of the swampy level-bedded limestone plains which emerge from the drier Mallee Plains of the Murray region, the "Ninety Mile Plains" lying between the latter and the South East. The south-eastern plains are broken up partly by the remains of volcanic foci in the south and also by "a remarkable series of stranded dunes"; and within the area there is a wide variety of fertility conditions.

Recorded Data.

Considering the indigenous inhabitants of this region from published records and maps, we find that the main group which occupied the South-East is known by varied forms of the name applied to it by Mrs. J. Smith—whose account is the most extensive—the "Booandik" tribe. A consideration of this term and the distribution of the tribe will be given in later paragraphs.

The available sources of published information may be briefly summarised as follows.

Mrs. J. Smith (2) wrote the earliest and most extensive account of these aborigines. But while her little book contains much that is of lasting value,

it is somewhat disappointing as an ethnographic record, in that most of its pages are devoted to describing her experiences in an endeavour to Christianise the natives. However, it remains the chief source of information on the South-East aborigines.

Howitt (3) apparently did not make any personal observations on these people, and for his information drew on those of Mrs. Smith and her son, Mr. D. S. Stewart.

Mathews (4, 5) has dealt mainly with their language and grammar, his information being gathered from "a few surviving members" with whom, he states, he was fortunate enough to make personal contact.

Thomas (6) makes brief mention of the Booandik; and although he gives no reference as to his source of information, he has obviously drawn on the records of Mrs. Smith.

Ward's small publication (7) deals with the development of the South-East by the white occupation and makes only occasional reference to its indigenous inhabitants.

Fison and Howitt (8) refer to "the Mt. Gambier tribe" without naming it, and quote remarks and observations of D. S. Stewart.

Curr (9) deals briefly with this tribe; his few pages consisting of some notes on their language and a short vocabulary. His informant was D. S. Stewart, of Mt. Gambier.

East's reference (10) is a brief one, concerned in discussing the distribution of South Australian tribes.

Angas, in the account (11) of his early journey through the South-East, provides some useful and interesting observations.

Schmidt (12) gives only a brief account of the natives here concerned. and has drawn on various of the afore-mentioned for his data.

Brough Smyth (13) makes several brief references to the aborigines of the Mount Gambier district; but these merely quote observations given to Fison by D. S. Stewart. In fact, his large two-volume work gives very little information concerning the natives of the far western region of Victoria; this is unfortunate, because the lower South-East and south-western Victoria are closely related in certain geographical aspects.

Dawson (14) refers very briefly to the natives of "the Mount Gambier district."

Woods (15), in this particular work, is mainly historical, and devotes little space to the aborigines. He refers to those of the Lakes Alexandrina and Albert district, and states that "Further east there were the Booandik, the Tatiara, Padthaway, Naracoorte, and the south-east coast tribes, which occupied the country as far east as the Glenelg River near the Victorian border."

Taplin, in his book on the aborigines of South Australia (16), devotes sections to the Tatiara, Padthaway, and south-east coast tribes; but these pages contain little concerning those under present discussion, and no mention is made of the Buandik.

Worsnop (17) makes a brief reference to the natives near Lake Bonney.

Tribe Synonyms.

The name given to the main inhabitants of the South-East naturally varies with different writers. Mrs. Smith, whose contact with these natives was a close and prolonged one, has termed them the "Booandik." Others, although drawing on Mrs. Smith for their information, have preferred a different spelling of this name, as, for example, "Buandik" (Howitt, Schmidt), as "Boandik" (Ward, East, Woods). Mathews, who secured some of his

information first-hand from a few surviving aborigines, disagreed with the phonetics of Mrs. Smith. He writes: ". . . whose name she erroneously gave as Booandik." He expresses it as "Bungandity." Dawson (p. 76) refers to the aborigines of the Mt. Gambier district as the "Bung'andaetch." It is also interesting to note that the name applied to the immediately neighbouring Victorian tribe has some slight phonetic similarity—the "Gournditch" (see Fison and Howitt, p. 278).

Similarly for neighbouring tribes (or groups of the one main tribe?) we have:—

Pinejunga (Smith), Penganka (Ward), Painchunga (Howitt).
Mootatunga (Smith), Moatatunga (Howitt).
Wichintunga (Smith), Wiatunga (Howitt).
Polinjunga (Smith), Taloinjunga (Howitt).

W. W. Thorpe (18) published an article on Australian tribal synonyms, but his mention of names concerned here is quite incomplete.

To bring the spelling of the name of the main tribe under discussion into conformity with the phonetic values now generally accepted, it is proposed to adhere to the version preferred by Howitt, namely, "Buandik."

Distribution of the Aborigines.

From published records it is difficult to decide whether we should consider the South-East as having been occupied by one large tribe, consisting of a number of associated local groups, each with its own terrain, name, and dialect; or, as Mathews describes them, occupied by "an aggregate of about half-a-dozen small tribes." The following notes will summarise these points according to various writers; but it must be remembered that the term "South-East" has, in the early records, been used in a poorly defined manner.

Mrs. Smith has stated that these aborigines consisted of five separate tribes. Her statement (p. ix.) reads: "The aborigines of the South-East were divided into five tribes, each occupying its own territory, and using different dialects of the same language. Their names were 'Booandik,' 'Pinejunga,' 'Mootatunga,' 'Wichintunga,' and 'Polinjunga'." She states that the Buandik was the largest, and ". . . occupied that tract of country extending from the mouth of the Glenelg River to Rivoli Bay North (Beachport), for about thirty miles inland."

Mathews wrote of the "Bungandity" that they ". . . occupied the country around Mt. Gambier, County of Grey, South Australia, and extended easterly into Victoria as far as the valley of the Glenelg River." The other groups mentioned by Mrs. Smith no doubt make up his ". . . aggregate of about half-a-dozen small tribes, the limits of whose territory may be indicated approximately by a line drawn from Kingston to Bordertown, and thence southerly to the sea coast." (p. 59.)

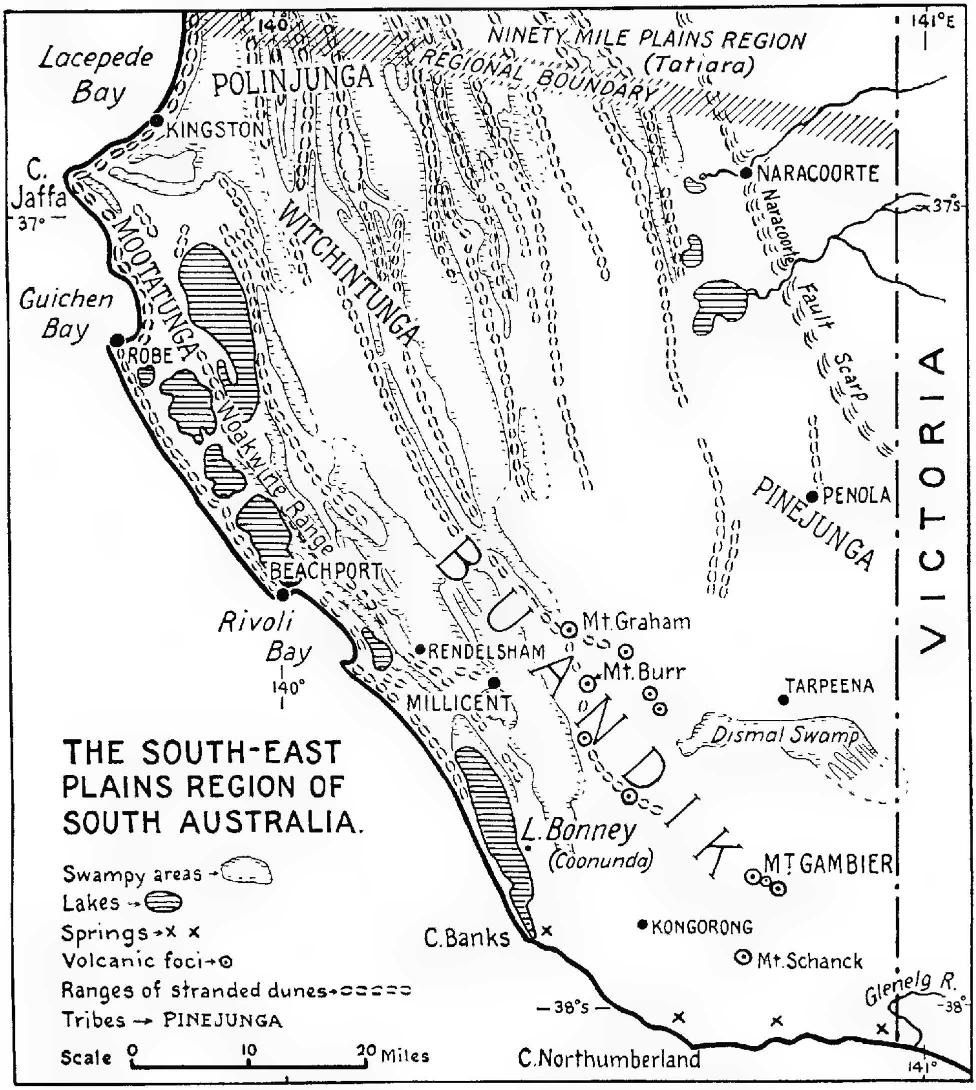
J. J. East (p. 3) describes "The River Murray Tribes" as occupying ". . . the South-East of the province and a portion of the Adelaide hills." One of the three main divisions of this area he terms "The T(h)unga or Coorong Blacks, who reach from Lake Alexandrina to Mt. Gambier." He describes the "Boandiks" as being a tribe of the Thunga section.

Howitt (p. 68) refers to the Buandik as occupying the coast between the Glenelg River and Rivoli Bay. For his details he has drawn mainly on the records of Mrs. Smith and information from Mr. D. S. Stewart.

Dawson, although his work deals almost exclusively with the aborigines of South-western Victoria, makes little reference to those occupying the country which we now term the South-East. In fact, his only statement

which bears on the present discussion is one referring (p. 76) to ". . . the Bung'andaetch who inhabit the Mount Gambier district. . . ."

One of Ward's references to the natives states that the inmates of the Aborigines' Home—which was located near Mt. Gambier back in the middle of last century—consisted of ". . . descendants of the Penganka and



Boandik tribes, who formerly occupied the country from Mount Gambier to Tatiara. The dominion of the Boandiks comprised the southerly portion of that area, and the Pengankas roamed from Penola northwards." (p. 80.)

It will be seen that several of these writers, in refering to the Buandik, mention them as natives who lived in the Mt. Gambier district; but none of these observers had anything like such close acquaintanceship with them as that of Mrs. Smith, and were probably not aware of the actual tribal distribution.

From general accounts of our Australian aborigines, it may be safely assumed that natural regions, as defined[1] in modern geographical studies, were an important factor in the distribution of the indigenous population. A more favourably endowed region would naturally tend to constitute the territory of a stronger tribe, just as strong topographical features like ranges or barren plains would tend to form natural boundaries between adjacent tribes or groups. As stated above, it is felt that the work of Fenner can be of assistance in studying the native group under present discussion.

In adopting Fenner's definition of the "South-East" and applying to it the somewhat scant information contained in the above extracts from available records, it appears that this area was occupied mainly by the Buandik natives. If we accept Mrs. Smith's statement that their territory extended thirty miles inland from the coast, then it would embrace most of this striking "natural region" composed of alternate ranges (ancient stranded dunes and ridges formed of volcanic cones) and swampy flats.

The sea coast formed the westerly and southerly boundaries of this tribe, while the Glenelg River was probably its south-easterly limit. On the northerly and north-easterly aspects we do not find such definitely limiting boundaries; for on the northern side of the territory attributed to the Buandik, we have a much more open type of country which merges into the "Ninety Mile Plains" (Fenner) or Tatiara region.

Beyond mentioning that the Pinejunga (Penganka, Painchunga) were inland from the Mt. Gambier natives, and the Wichintunga inland from the Mootatunga, or Robe district natives, the published data do not enlighten us concerning the make-up of these northerly neighbours, or of their relationship with the Buandik. Nor do we know much of the still more northerly natives known as the Tatiara (Tattayarra), or Merkanie (East) group.

Concerning the relationship between the Buandik and their easterly neighbours, we know little beyond that—according to Fison and Howitt—their customs and social organisation appear to be somewhat similar. A detailed comparison of Mrs. Smith's data on the Buandik, and Dawson's on the south-western Victorian aborigines, might prove a profitable study.

Present consideration of the published accounts of these natives will now be limited to stating briefly, for the guidance of any further work, the main sources of information bearing on their social organisation and language.

Social Organisation.—Smith, pp. ix,-xi.; 3-5. Fison and Howitt, pp. 168-171. Howitt, p. 250. Curr, pp. 460-463. Taplin, p. 61. Mathews (5).

Language.—Mathews (4), p. 250; and (5). Smith, p. 125, *et seq.* Curr, vol. iii., pp. 437, 462-465. Taplin, p. 142, *et seq.*

Legends.—Smith, pp. 14-24.

The following notes are the result of observations made by the writer during several vacation trips to the Millicent district. They are largely based on information secured from an old resident of that township, the late Mr. George Wallace, whose experience carried him back to 1859, long before the township was actually established in 1871. The notes cover only a limited range of subjects, nevertheless they contain some interesting points from the clear recollections of an observer of the aborigines before the newly-settled white population had caused complete disorganisation of their life and customs.

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[1] A widely accepted definition of a Natural Region is: "An area where the topography, climate, productions, and potentialities may be described with the maximum number of general statements and the minimum number of exceptions"; or "a tract of country stamped with an aspect of unity."

Distribution.—At the time of Wallace's earliest days in the district, the native population was declining, and had become more or less congregated into a number of localized groups, each group being made up of the customary smaller "family groups." These local groups occupied fairly well-defined regions, and those recalled by Wallace were spoken of in his early days as the Robe, Woakwine, Mount Burr, Mayurra, and Kongorong (German Creek) natives. He could not remember any of the aboriginal names for these groups.

To those acquainted with the South-East, it will be obvious that these localities formed topographically suitable hunting and camping areas. All of them were quite reasonable expanses of territory with adequate and permanent water supplies; nearly all included a range or portion of a range; a number of these "beats" were separated by wide areas of almost permanently swampy country.

Robe Section (The Mootatunga of Smith).—These natives had as neighbours the Kingston group or Polinjunga (Smith), who further north linked up with the Coorong natives. This Robe group was almost coastal, but their territory included the many lakes of that district and the north-westerly portion of the Woakwine Range.

Woakwine.—These natives occupied the Rendelsham-Beachport region of the Woakwine Range. This also was practically a coastal beat with Lake Frome and permanent fresh-water swamps as their water supplies. It is interesting to note that Angas (p. 154), when writing of this particular region, stated that ". . . these natives belonged to a tribe totally different from those of the Milmendura whom we had met along the shores of the Coorong, and were very inferior to them in physical appearance: their features were remarkably ugly, with a simple silliness of expression, and their figures extremely slight and attenuated, with the abdomen of a disproportionate size. They were filthy and wretched in the extreme; all their teeth were black and rotten; their skin was dry, and that of one man presented a purplish-red colour."

Mount Burr-Mount Graham.—This range is situated some few miles east of Millicent, separated from the Woakwine Range by a wide and, in past years, very swampy plain. It consists largely of areas of volcanic rocks, mostly tufaceous, and embraces extensive "stringy bark" forests; small lakes occur in the volcanic areas and caves in the limestones.

This area was the location of one of the earliest sheep stations in the South-East, and there are ample records to show how stoutly the natives of this particular territory resisted the usurpation of their home ground.

The following extract from Tolmer's "Reminiscences" (19) is of interest in that it concerns an occurrence which gave rise to considerable official correspondence and enquiry. Writing of Mr. Leake, whose head station was in the vicinity of what is now known as Lake Leake, his journal states (November, 1844):—"He complained sadly of the constant thefts committed by the natives in the neighbourhood, and their constantly dodging his shepherds from tree to tree, shaking their spears and putting them in the greatest fear. At night, notwithstanding the vigilance of his men, they managed to get into the sheepyards and carry away the sheep. He had lost fourteen rams in that way. He said they are very numerous but small in stature, very active and fierce. Not long before, about sixty or seventy attacked the shepherd on the run, and drove him back; although he was well armed, and fired several shots at them, they succeeded in spearing and taking away from thirty to forty sheep. Mr. Leake on this occasion went with his men

in pursuit, and soon came up with the natives in possession of the sheep. They then commenced throwing spears at the Europeans, who immediately fired amongst them, killing one and wounding another. One of the shepherds received a spear wound in his arm during the affray; since this affair, however they have not been quite so bold."

In an official note to Mr. Lillicrap, dated 20th May, 1845, Mr. Leake wrote: "We are attacked on all sides by blacks, if something be not done it will not be safe to go in any part of the country."

Mayurra.—This territory consisted of that portion of the Woakwine Range to the immediate west of Millicent. It was associated with the coast a few miles still further to the westward. Besides other water supplies, this beat adjoined the northern end of Lake Bonney (sometimes termed Lake Coonunda), a fine stretch of water about twenty-five miles in length.

Kongorong.—A tract of country west of Mount Gambier and adjacent to the southern end of Lake Bonney. This district was also known locally as the "German Creek."

The above-mentioned localities were all well watered and thickly timbered areas. That they abounded in native game in the early days of civilized settlement is amply substantiated by early records, and the conditions of climate and food potentialities probably made these districts capable of holding a larger native population than that suggested in Wallace's statements on their numbers in his early days.

These subdivisions mentioned by Wallace might well be looked upon as the actual remnants of definite local groups of the Buandik tribe, and probably constituted most of the sections into which they were divided before detribalization had commenced through white man's intrusion into their homeland. But from our consideration of the published records it seems that we must add at least one more local group, namely, that occupying the Mt. Gambier region; possibly others also, as the following extract indicates.

A report from E. P. J. Sturt, J.P., of Mt. Gambier, to the Colonial Secretary, 30th April, 1846, contains the following: " . . . the natives have (as the winter approaches) been mustering in great numbers, and are united with many of the Glenelg tribe, numbers of which have left that River owing to the numerous murders and depredations committed by them. This circumstance will, I fear, render them seriously troublesome for some time."

Population.—According to Wallace, these local groups consisted of roughly sixty to a hundred individuals; each group, of course, being made up of the usual small family groups.

Language.—My informant had no personal knowledge of the language, but said it was generally accepted that these local groups spoke slightly different "dialects," but were able to converse quite readily one with another.

Domestic Life.—The smallest family group generally consisted of a monogamous union—although occasionally a man might have two wives—and an average of two or three children. Mrs. Smith has stated that ". . . polygamy was the rule: most of them had two wives, but some had as many as five."

Their wurlies were constructed of boughs; skins were only rarely used to ensure more effective shelter.

The only clothing Wallace could recall as being in regular use was a sort of girdle or "skirtlet" of emu feathers.

Their bodies were scarred in the manner customary with the Australian aborigines.

Their diet seemed to consist largely of kangaroo, opossum and emu, all of which were abundant. He could not recall having seen any fishing activities even though lakes and almost permanent swamps and lagoons existed in the district. Smith (p. xi.) includes fish as one of the chief items of diet. The same writer mentions "fine roots" and "candart-seed." It seems likely, of course, that cereals and other vegetable foods were used by these aborigines, but it is an interesting point that enquiries and examination of many camp sites have failed to bring under notice the use or existence of the typical large grinding stones used by the natives in food preparation.

Mrs. Smith mentioned the making of fire with "grass tree sticks" by the rotary method. Wallace said he had never personally observed the making of fire, but had often noticed how particular they were to keep their fires going. In order to make a fire in another place they would carry a piece of burning sheoak bark.

Angas (vol. i., p. 155) mentions an interesting point concerning fish catching by these natives. During his journey he observed in the region just inland from Rivoli Bay (Beachport):—"On some of the swamps that natives had built weirs of mud, like a dam wall, extending across from side to side, for the purpose of taking the very small mucilaginous fishes that abound in the water when these swamps are flooded." He also writes of them using large haliotis shells for carrying water, and drinking an infusion made from the cones of the Banksia.

Stone Implements.—The present writer has made collections of stone implements from many camp sites in the district under discussion. Implements of the smaller varieties are fairly representative of those found on native camp sites in general; even to the small microlithic types like the so-called "crescent" and "chipped-back knives." But on the whole the south-eastern implements do not show the symmetry in design and technique which characterises those from many of the far northern parts of the State. Although true flint is abundant on certain limestone formations both on coastal and other regions of the South-East, the native implements are, for the most part, lithoclastically unattractive. Wallace stated that he had frequently seen in use the polished stone tomahawk, typical of the South-East; but always as a hand chopper, and not hafted in a handle. The numbers of axe heads which have been collected in this lower part of the State are considerable; it must have been a very common implement. It is generally accepted that these native axe heads were traded across from one or other of several well-known sources in Victoria, the material from which they are formed being quite foreign to this region.

It would be interesting to hear confirmation of Wallace's observation that the stone axe heads were so much used without being mounted. It is well known that the white man's iron tomahawk was, at an early date, introduced into the natives' equipment (Sturt describes his own distribution of them among the natives during his classic journey down the River Murray). By Wallace's time, the use of the native stone axe head as a hand-gripped implement may represent a degenerative stage of its usage.

Wood Implements.—Wallace stated that almost all the native wooden implements were made from sheoak (Casuarina).

Spear shafts were secured from the ti-tree (Melaleuca), which, of course, is still abundant in certain swampy areas of the South-East. The spear shaft was pointed, and had a wood barb attached.

Boomerangs of both the ordinary and returning varieties were used.

A pick-shaped implement made entirely of wood was fairly common.

The natives used a bird snare consisting of a stick about eight feet long with a running noose attached to its end. The noose string was made from kangaroo sinew.

An interesting reference to wood implements occurs in the following extract, taken from an official report, dated 28th February, 1865. Ranger Egan, reporting on the natives of the Tarpeena district, wrote that ". . . a great mob of them went away to the mallee scrub for spears and waddies. The scrub is more than 100 miles from this. I met them in the Province of Victoria returning with large quantities of those warlike instruments."

Hunting.—Wallace was definite on the method of bird snaring, which does not seem to have been recorded very often for the Australian native. As mentioned above, it consisted of a long stick with a noose at its end. It was largely used for catching wild turkey. The hunter would conceal himself in a clump of bushes, and the bird, being of an inquisitive disposition, would be attracted by movements judiciously executed by the native. The latter, with his customary patience, waited until a suitable moment when he would slip the noose over the bird's head. This form of bird snare has been recorded by several writers, and their accounts correspond with the above and also give some further details: Angas (vol. i., p. 148), Thomas (p. 97), Pyke (Ref. 20, p. 58), Brough Smyth (vol. i., pp. 192-196, and vol. ii., p. 314). This exquisite point of hunting technique on the part of the Australian native is one which I have heard stressed by more than one observer. He undoubtedly possessed consummate skill and patience in getting himself and his prey into close proximity, and remaining perfectly stationary until that fleeting but sufficient moment when his quarry allowed its attention to be directed elsewhere. His missile or snare was then put into action with lightning rapidity. Wallace informed me that he had actually seen a native catch a wild pigeon by this snaring method. He also stated that although he had not witnessed the natives catching wild duck, it was locally quite accredited that in securing duck they would quietly swim up to the birds, very quickly drag one under the water and screw its neck, all with scarcely any observable commotion. This method has, of course, been recorded for the aborigines in various places. They also showed the customary native skill in spear throwing; and he knew a noted spear thrower named Billy who could kill parrots by this means.

Customs and Ceremonies.—My informant expressed no knowledge of initiation ceremonies, if such were practised. Mrs. Smith makes no mention in her work of initiation customs or ceremonies. Concerning the eastern neighbours of the Buandik, Fison and Howitt make a note (p. 193): "The Gournditch-mara tribe of Western Victoria, according to the Rev. J. H. Stahle, had no initiation ceremonies." Another reference to the same effect occurs on p. 278.

Smoke signals were commonly used to attract attention between parties of aborigines, but Wallace was not aware of any message system by such means.

The natives of the district were accustomed to meet for what he took to be friendly gatherings. These mostly took place in the vicinity of Mt. Burr. Messengers would be sent to various groups, who would agree to meet in so many moons time. They came from as far as Kingston and the Coorong. The meeting seemed to be mainly for corroboree purposes. They generally became quite excited, and worked up into a fight, during which someone would be seriously injured or even killed; then all the fighting would cease. Otherwise, to Wallace, these corroborees seemed uninteresting affairs. The

womenfolk did the singing and beat their sticks on rolled-up opossum skin rugs, while the dancing consisted chiefly of a simple leg-shaking sort of dance. He knew of one corroboree occasion when a native named Billy Glen—who was an expert spear thrower—had secured some drink and became very excited. As a challenge for somebody to come out and have a duel with him, he threw a spear some distance into a neighbouring camp. It passed through the wall of a wurlie and through the back of a man who was sitting beside his fire. Billy was taken along, and the fatally injured native was given one of the pick-shaped implements, and as well as he could he belted Billy over the head with many blows. The latter was almost killed by the injuries, and died not long after the event.

Mrs. Smith has stated (p. ix.) of these natives that ". . . although they occasionally met on friendly terms to hold a 'murapena' (corroboree), it usually eventuated in a fight, in which one or two were killed and afterwards eaten."

Burial.—My informant related his observation of an interesting example of the "platform" burials which have been recorded for the Coorong region. On one of his stock-droving trips to the Adelaide district they heard of some native burials on a small island situated in a lagoon near Salt Creek. He asked their blackboy to show them the place, but the native persistently refused, saying it would mean death to him. Wallace and his companions found the spot, and the burial consisted of two bodies on a platform—said to be "king and queen." Arranged below and around the platform was a circle of seven or eight other bodies placed in a sitting posture.

Another informant stated that he had seen several native bodies unearthed in the Millicent district, and all the skeletons were in a sitting posture with the limbs flexed.

Angas mentioned (vol. i. p. 158) that near Rivoli Bay, "On a grassy knoll, surrounded by sheoaks, we met with a mound of limestones, like a cairn, which we conjectured to have been placed there by the natives above the bodies of their dead to protect them from the wild dogs."

The writer desires to record his thanks to Dr. Fenner and Mr. N. B. Tindale for helpful suggestions in the compilation of these notes.

Summary.

The amount of published information concerning the life and customs of the natives of the south-east of South Australia is scant.

Part I of this study contains the sources of information published as scientific communications.

The South-East was mainly occupied by a tribe, or collection of local groups of aborigines, who were first described as the "Booandik" tribe. It is suggested that "Buandik" be adopted as the preferable spelling of this name.

Little has been written of the groups who linked up the Buandik with those of the Coorong and the better known Narrinyeri groups; or of those who inhabited the region between the Buandik and the more northerly people of the Tatiara (Tattayarra) or Ninety Mile Plains country.

Mention is made of the relation between "natural regions" and tribal territories.

Some observations and notes collected by the writer during recent years are included.

The object of the paper is to pave the way for further and more intensive research on the little known aborigines who inhabited the southernmost parts of South Australia.

References.

1. Fenner, Charles—"South Australia. A Geographical Study" (1931).
2. Smith, Mrs. James—"The Booandik Tribe of South Australian Aborigines," Adelaide (1880).
3. Howitt, A. W.—"The Native Tribes of South-East Australia" (1904), pp. 68, 250.
4. Mathews, R. H.—"Language of the Bungandity Tribe, South Australia." Proc. Roy. Soc. N.S.W., **vol. xxxvii.** (1903), p. 59.
5. ———— "The Victorian Aborigines." American Anthropologist, **vol. xi.** (1898), pp. 331-336.
6. Thomas, N. W.—"Natives of Australia," London (1906), p. 246.
7. Ward, E.—"The South-Eastern District of South Australia," Adelaide (1869), p. 80.
8. Fison, L., and Howitt, A. W.—"Kamilaroi and Kurnai" (1880), p. 168.
9. Curr, E. M.—"The Australian Race" (1887), **vol. iii.**, p. 460.
10. East, J. J.—"The Aborigines of South and Central Australia." Pamphlet read before Field Nat. Sect. of Roy. Soc., S. Aust., July 16, 1889, p. 3.
11. Angas, George French—"Savage Life and Scenes in Australia and New Zealand" (1847), **vol. i.**
12. Schmidt, P. W.—"Die Gliederung der Australischen Sprachen," Wein. (1919), p. 75.
13. Smyth, R. Brough—"The Aborigines of Victoria" (1878). 2 Vols. **Vol. i.**, pp. xxvi., 92, 235; **vol. ii.**, p. 269.
14. Dawson, J.—"Australian Aborigines," Melbourne (1881), p. 76.
15. Woods, J. D.—"The Province of South Australia," Adelaide (1894), p. 399.
16. Taplin, G.—"The Folklore, Manners, Customs, and Languages of the South Australian Aborigines," Adelaide (1879).
17. Worsnop, T.—"Aborigines of Australia," Adelaide (1897), p. 149.
18. Thorpe, W. W.—"Australian Tribal Names with their Synonyms," Rec. Aust. Mus., **vol. viii.**, pt. 4 (1913), p. 162.
19. Tolmer, Alex.—"Reminiscences," London (1882), **vol. ii.**, p. 13.
20. Pyke, W. T.—"Thirty Years Among the Blacks of Australia," London (1904).

THE MONTHLY PRECIPITATION-EVAPORATION AS DETERMINED BY SATURATION RATIO IN AUSTRALIA, DEFICIT.

BY J. DAVIDSON, D.SC.

Summary

During an investigation of the geographical distribution and seasonal occurrence of the "springtail" *Smynthurus viridis* L. (Collembola) in Australia, an attempt was made to interpret the moisture "conditions" at the soil surface, during each month, in certain States of the Commonwealth (Davidson, 1933, 1934).

THE MONTHLY PRECIPITATION-EVAPORATION RATIO IN AUSTRALIA, AS DETERMINED BY SATURATION DEFICIT.

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[Read May 10, 1934.]

During an investigation of the geographical distribution and seasonal occurrence of the "springtail" *Smynthurus viridis* L. (Collembola) in Australia, an attempt was made to interpret the moisture "conditions" at the soil surface, during each month, in certain States of the Commonwealth (Davidson, 1933, 1934).

The degree of wetness or dryness at the soil surface during any defined period is determined primarily by rainfall; soil type and its vegetative covering are important secondary factors. The efficiency of rainfall in this respect depends upon the amount and distribution of precipitation (number of rain days), together with run-off and percolation through the soil, in relation to the loss due to evaporation. When evaporation exceeds precipitation, dry conditions may obtain, the intensity of which will depend upon the duration of the period and the rainfall-evaporation ratio.

Several authors have devised formulae for the purpose of expressing the intensity of aridity in an area. In general these formulae are based on consideration of average values, for the year, of certain of the major climatic factors, namely rainfall, temperature, saturation deficit and evaporation. Certain of these formulae have been discussed with reference to Australia by Prescott (1931, 1934) and Andrews and Maze (1933). The latter authors defined the monthly conditions of aridity in Australia using de Martonne's index $\frac{P}{T+10}$, in which the precipitation in millimetres is related to temperature in degrees centigrade. They decided against the use of the climatic factors of relative humidity and evaporation for this purpose for various reasons, chiefly owing to the scarcity of records over a large portion of Australia. As regards saturation deficit, they state "the conception of saturation deficit is still a comparatively new one." It may be observed that the relation of evaporation from a free water surface to the vapour pressure deficit of the air is a fundamental law which was established by Dalton in 1798. Various formulae which have been used to express this relationship, with a view to measuring the loss of water due to evaporation, are discussed by Rohwer (1931).

For the purpose of the ecological studies referred to above, the writer desired to express the efficiency of precipitation in relation to the moisture at the soil surface, month by month, in the southern portion of the Commonwealth. Where records for evaporation and precipitation are available, the rainfall-evaporation ratio in an area affords a valuable guide in this respect (fig. 1).

Evaporation is governed by the temperature, relative humidity, pressure and movement of the air. The measurement of evaporation affords a concise expression of the loss of water from an exposed surface, but the character of the evaporating surface in nature, namely the soil and its vegetative covering, offers considerable difficulty owing to its complexity and variability; the difficulty of obtaining precise values for movement of the air (wind) in local situations is also

important. The values to be assigned to these variables cannot be adequately expressed at the present stage of our knowledge, therefore any formulae which may be used to evaluate evaporation in nature can be expected to give only a general approximation to the actual values. From an ecological point of view,

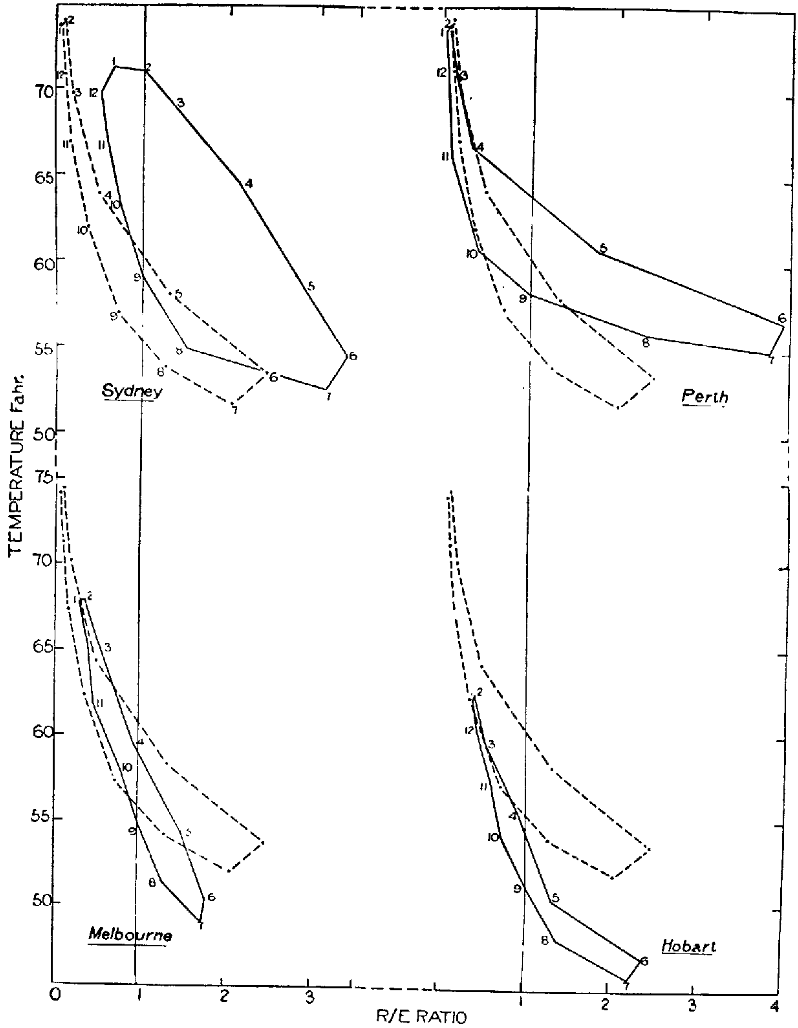


Fig. 1.

Showing the relation of mean monthly R/E ratio and temperature at four capital cities in Australia, compared with Adelaide (broken line). The data are from actual records, Official Year Book, Commonwealth of Australia, 1930. The vertical lines drawn through the graphs represent rainfall equals evaporation. (From Davidson, J., C.S.I.R., Bull. 79, 1934.)

however, the formulae are valuable in studies relating to the effect of climate on the distribution and seasonal abundance of animals and plants.

The vapour pressure deficit of the air (saturation deficit) is the major factor influencing evaporation. It is a function of the temperature and relative humidity of the air and can be calculated for stations where these data are available. From

Dalton's law of evaporation it is known that the intensity of evaporation in a controlled atmosphere is almost proportional to the saturation deficit of the air.

The writer employed a method, with reference to South Australia, whereby the mean monthly values for saturation deficit, calculated for 21 stations, could be expressed in terms of evaporation by reference to evaporation records for Adelaide. By this means the approximate areas in the State, in which the mean rainfall (recorded) exceeds the mean evaporation (calculated), were defined for each month. The areas for each month were then superposed and a composite map was obtained showing the areas and months in which the mean rainfall exceeds evaporation (Davidson, 1933). The same method was used in a later paper (Davidson, 1934) with reference to Western Australia, Victoria, Tasmania and New South Wales. Values for saturation deficit were calculated for 17 stations in Western Australia, and for 45, 15 and 36 stations, respectively, in the remaining States. Values for evaporation at these stations were obtained by reference to the evaporation records for Perth, Melbourne, Hobart and Sydney, respectively. The same method has been applied to the remaining parts of the Commonwealth. Values for saturation deficit were calculated for 85 stations in Queensland, and 16 stations in the Northern Territory and northern portion of Western Australia. Values for evaporation at these stations were obtained by reference to evaporation records for Brisbane and Alice Springs, respectively.[1] With the information obtained a map of Australia was prepared, on a scale 1 inch = 48 miles, showing the months and approximate areas in which the mean rainfall exceeds evaporation as determined by saturation deficit. This is the map presented with the present paper.

The southern portion of Australia lies in the zone of winter rainfall. In the northern portion of the continent the greatest precipitation occurs during the summer. The zones of winter and summer rainfall type are indicated on the map; the boundaries have been taken from the official map of the Commonwealth Bureau of Meteorology, showing the mean monthly distribution of rainfall over Australia, revised up to 1925 (January, 1927).

The greatest precipitation occurs over the coastal belt; the rainfall decreases progressively with increased distance from the coast.

In the zone of winter rainfall, low temperatures and high humidity during the winter are accompanied by relatively low evaporation. Therefore adequate moisture is maintained at the soil surface over a relatively wide area, particularly during June and July; with the onset of the dry season conditions become increasingly dry (fig. 1).

In the northern portion of the Continent, on the other hand, low rainfall during the winter months results in a relatively low rainfall-evaporation ratio, which may result in dry conditions; during the period of greatest precipitation, high temperatures are accompanied by relatively high evaporation. These factors restrict the area in which adequate moisture conditions are maintained at the soil surface, as is shown by the shaded areas on the map.

The moisture conditions on the surface soil are important in relation to the fauna of the soil surface; they are also important in relation to the germination of seeds and the growth of seedlings. In general, however, plant growth depends upon the moisture in the deeper layers of the soil. Where temperature is favourable, vigorous growth of certain plants, for instance grasses, will occur in an area where the surface conditions are dry, so long as moisture is available in the lower depths of the soil. This is a feature of the grassland areas of Queensland and

(1) The necessary data were obtained in the Official Year Book, Commonwealth of Australia, 1932; and Pamphlet No. 42, Commonwealth C.S.I.R. (1933).

Northern Australia. The rate at which the soil moisture is used up will depend upon the transpiration activity of the plants and the intensity of evaporation in relation to rainfall. Therefore the duration of the periods having particular values for R/E are important when considering the ratio as an index of aridity.

It is evident that the monthly R/E ratio may be a useful single factor index for defining aridity in Australia month by month. It will be necessary, however, to define the intensity of aridity which may be associated with particular values for R/E. The critical value for this ratio is $R/E = 1$, the total precipitation and evaporation for the month being balanced, particulary when rainfall is generally distributed (number of rain days). As the ratio exceeds one, the conditions will become increasingly wet, until saturation is maintained, when there may be excessive run-off or flooding. As the ratio falls below one, the conditions will become increasingly dry, the intensity of which will depend upon the value of the ratio and its duration.

REFERENCES.

1. ANDREWS, J., and MAZE, W. H. 1933. Proc. Linn. Soc. N.S.W., **vol. lviii.,** 105-120.

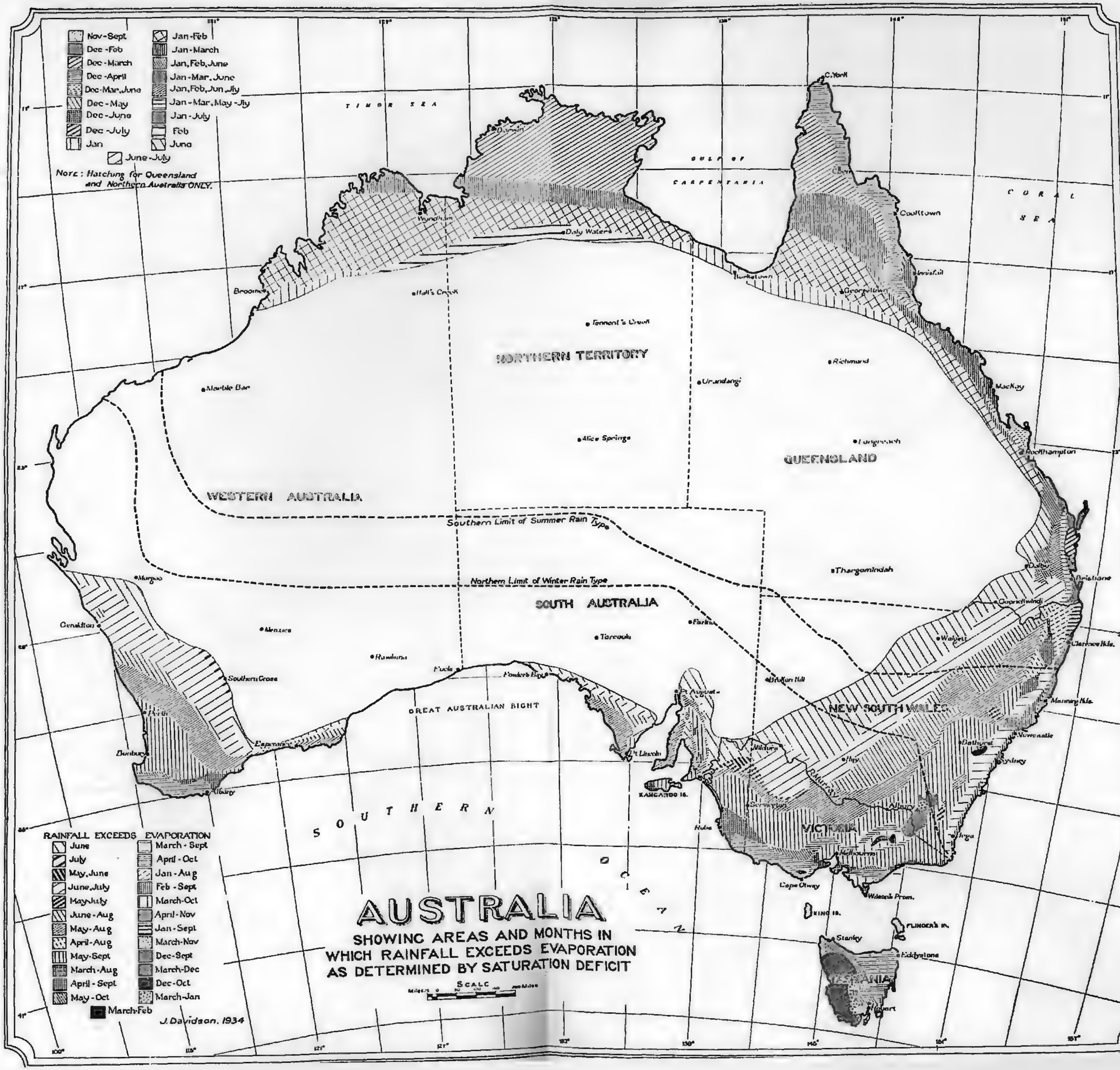
2. DAVIDSON, J. 1933. Australian Jl. Expt. Biol. Med. Sci., **vol. xi.,** p. 59-66.

3. DAVIDSON, J. 1934. Commonwealth C.S.I.R. Bull. 79.

4. PRESCOTT, J. A. 1931. Commonwealth C.S.I.R. Bull. 52, p. 32.

5. PRESCOTT, J. A. 1934. Proc. Roy. Soc. S. Aust., **vol. lviii.,** pp. 44-57.

6. ROHWER, C. 1931. U.S. Dept. Agric., Washington, Techn. Bull. 271.



Nov-Sept
Dec-Feb
Dec-March
Dec-April
Dec-Mar,June
Dec-May
Dec-June
Dec-July
Jan
Jan-Feb
Jan-March
Jan,Feb,June
Jan-Mar,June
Jan,Feb,Jun,Jly
Jan-Mar,May-Jly
Jan-July
Feb
June
June-July
NOTE: Hatching for Queensland and Northern Australia ONLY.
TIMOR SEA
GULF OF CARPENTARIA
CORAL SEA
C. York
Cooktown
Darwin
Wyndham
Daly Waters
Burketown
Innisfail
Georgetown
Broome
Hall's Creek
Tennent's Creek
NORTHERN TERRITORY
Richmond
Mackay
Urandangi
Marble Bar
Alice Springs
Longreach
QUEENSLAND
Rockhampton
WESTERN AUSTRALIA
Southern Limit of Summer Rain Type
Thargomindah
Dalby
Brisbane
Margoo
Northern Limit of Winter Rain Type
SOUTH AUSTRALIA
Goondiwindi
Geraldton
Menzies
Farina
Tarcoola
Walgett
Clarence Hds.
Rawlinna
Eucla
Fowlers Bay
Southern Cross
Broken Hill
Pt Augusta
Manning Hds.
GREAT AUSTRALIAN BIGHT
NEW SOUTH WALES
Perth
Bunbury
Esperance
Pt Lincoln
Mildura
Hay
Newcastle
Bathurst
Sydney
Albany
KANGAROO IS.
Albury
SOUTHERN OCEAN
Robe
VICTORIA
Eden
Melbourne
Cape Otway
Wilson's Prom.
KING IS.
FLINDER'S IS.
Stanley
Eddystone
TASMANIA
Hobart
RAINFALL EXCEEDS EVAPORATION
June
July
May, June
June, July
May-July
June-Aug
May-Aug
April-Aug
May-Sept
March-Aug
April-Sept
May-Oct
March-Feb
March-Sept
April-Oct
Jan-Aug
Feb-Sept
March-Oct
April-Nov
Jan-Sept
March-Nov
Dec-Sept
March-Dec
Dec-Oct
March-Jan
AUSTRALIA
SHOWING AREAS AND MONTHS IN WHICH RAINFALL EXCEEDS EVAPORATION AS DETERMINED BY SATURATION DEFICIT
SCALE
J. Davidson, 1934

ON THE AUSTRALIAN SPECIES OF JAPYGIDAE (THYSANURA).

BY H. WOMERSLEY, A.L.S., F.R.E.S.

Summary

Most of our knowledge of the Japygidae of Australia, and of the world as a whole, is due to that great authority on the group, Prof. F. Silvestri.

ON THE AUSTRALIAN SPECIES OF JAPYGIDAE (THYSANURA).

By H. Womersley, A.L.S., F.R.E.S., Entomologist, South Australian Museum.

[Read May 10, 1934.]

Most of our knowledge of the Japygidae of Australia, and of the world as a whole, is due to that great authority on the group, Prof. F. Silvestri.

Hitherto the following twelve species have been described from Australasia, eight of them being confined to Australia:—

Japyx longiseta Silv. - - -	West Australia
Japyx mjöbergi Silv. - - -	Queensland
Japyx tillyardi Silv. - - -	South Australia
Japyx leae Silv. - - -	Tasmania
Japyx froggatti Silv. - - -	New South Wales
Japyx michaelseni Silv. - - -	West Australia
Indjapyx papuasicus Silv. - -	Papua
Indjapyx sharpi Silv. - - -	Hawaii
Heterojapyx novae-hollandiae Verh. -	New Zealand
Heterojapyx victoriae Silv. - -	Victoria
Heterojapyx gallardi Till. - -	New South Wales
Parajapyx samoanus Silv. - -	Samoa

In this paper are described three new species of *Japyx,* two of *Heterojapyx* and one of *Parajapyx.* In addition, new records extend the range of distribution of some of these species within Australia.

I am greatly indebted to many friends for the opportunity of studying the material dealt with in this paper, and tender my thanks to them. In particular I would mention Prof. G. E. Nicholls and his students of Perth University who, in January, 1933, visited the south-west of Western Australia and brought back what probably constitutes one of the largest collections of these insects ever made in a single locality; no fewer than twenty-nine specimens were obtained, representing two known and one new species. Other specimens have been received from Western Australia through the kindness and enthusiasm of Mr. L. J. Glauert (of the Perth Museum) and Mr. D. C. Swan. In addition, I have other examples personally collected in the same State in 1931-2.

From Dr. R. J. Tillyard I have received material collected on Mount Kosciusko, Federal Territory. Mr. J. W. Evans also found a specimen in the same region, and in addition has given me a number of specimens from the Nelson District of New Zealand. In South Australia a number have been collected by Dr. J. Davidson, Mr. D. C. Swan, and the writer.

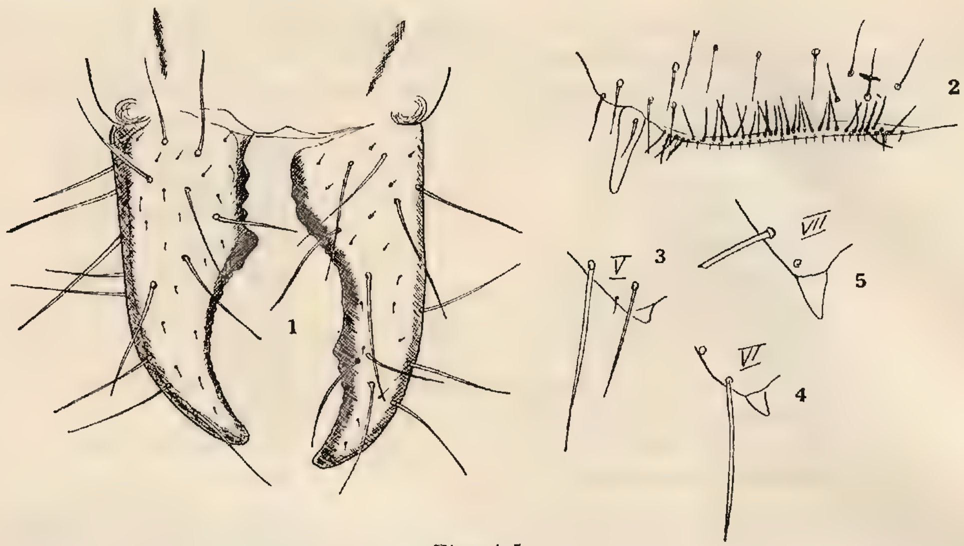
In the collections of the South Australian Museum there were previously two specimens, mounted on card, collected by the late Mr. A. M. Lea in Queensland and New South Wales.

The specific characters of the Japygidae are so obscure that it is very difficult to construct a serviceable key for their separation. At the conclusion of this paper I have attempted a key to the Australian species, which it is hoped will be serviceable as far as these species are concerned. It is, however, essential to consider the full description of each species before a final determination can be made.

Genus Japyx Halliday, 1863.

Japyx tillyardi Silv., 1930.

Of this species I have seen eight specimens altogether, all taken by Prof. Nicholls and his students. The localities and the number of specimens from each are:—Frankland River, South-West Australia, January, 1933 (2); Walpole Inlet, South-West Australia, January, 1933 (2); and Swarbrick, South-West Australia, January, 1933 (4).



Figs. 1-5.
Japyx tillyardi Silv.—1, forceps from above; 2, subcoxal organ of first abdominal sternite; 3, 4, 5, postero-lateral corners of tergites V., VI., and VII., respectively.

A close study of this material shows some minor differences from the description as given by Silvestri of the type from Mount Lofty, South Australia. The most important is that in all specimens the postero-lateral corners of tergite V. are slightly produced and not rounded.

Japyx froggatti Silv., 1930.

Sixteen specimens of this species were collected by Prof. Nicholls' party at Walpole Inlet, South-West Australia, in January, 1933. I have also seen a single specimen taken at Pinjarra, West Australia in September, 1931, by Mr. D. C. Swan.

Japyx michaelseni Silv., 1930.

Syn. *Japyx longiseta* Silv., 1908 *(ad partem)*.

This species was originally described from West Australia, but I have a specimen collected by Mr. J. W. Evans at Whangamoa, near Nelson, New Zealand, in which I can detect no difference from Silvestri's description.

Japyx mjöbergi Silv., 1928.

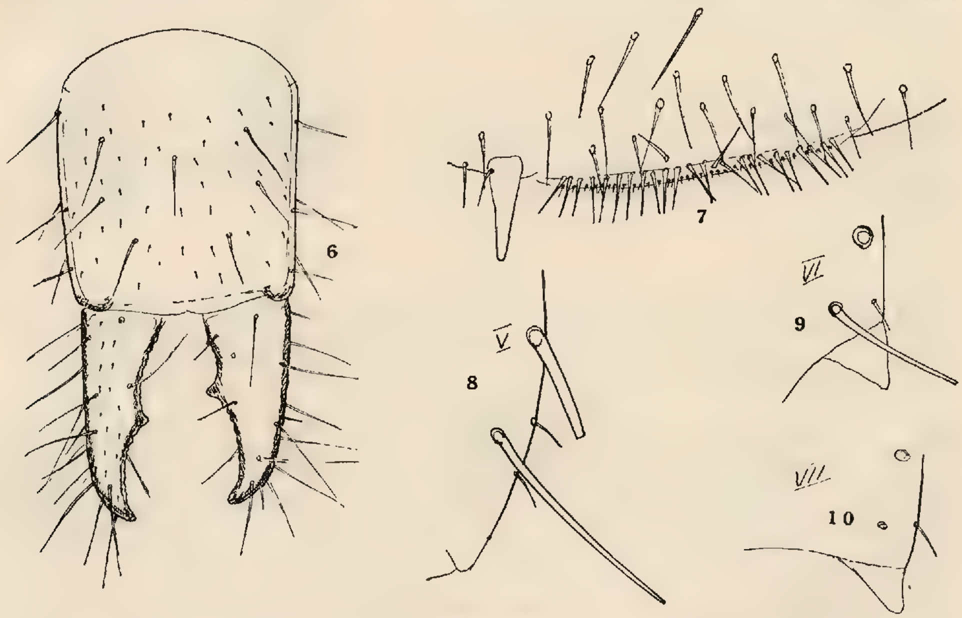
I have before me two specimens which conform to the description of this species. One was found in soil in my garden at Glen Osmond, Adelaide, South Australia, in 1933. The other was taken by Mr. Swan, also at Glen Osmond, in May of the same year.

Japyx longiseta Silv., 1908.

A single example collected by Mr. Swan at Pinjarra, West Australia, in September, 1931, can be referred to this species.

Japyx westraliense, n. sp.

Description.—Colour, cream, except on abdominal segments VIII.-X., which are yellowish, and the forceps, which are of a still deeper yellow. Head above with 15-16 long setae and a few shorter ones on each side. Antennae 24-segmented, segment III. rather longer than wide, the longer setae 0·15 mm., segment X. as wide as long, ultimate and penultimate segments only slightly elongated, the last slightly shorter than the last but one, all segments except the last two with the setae in two well-defined rows, the last with the setae not so orientated, sensory setae on IV.-VI. 3-3-4, these slightly shorter than the ordinary setae; maxillary palpi with 4 pectinate inner lamellae and an inner process; labial palpi elongate



Figs. 6-10.

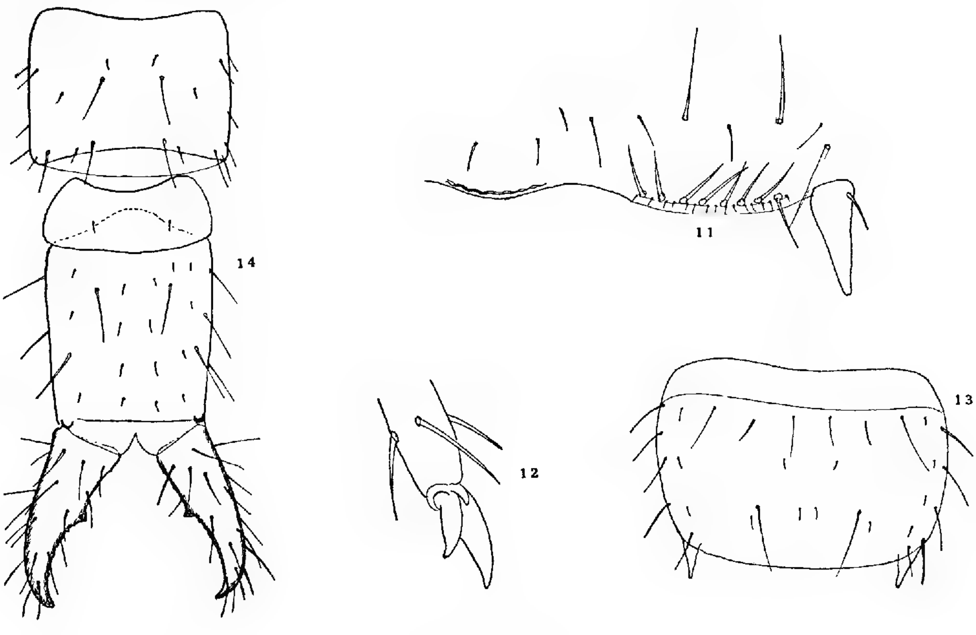
Japyx froggatti Silv.—6, segment X. and forceps from above; 7, subcoxal organ of first abdominal sternite; 8, 9, 10, postero-lateral corners of tergites V., VI., and VII., respectively.

380 μ. long by 180 μ. wide. Thorax: pronotum with 3 very long setae on each side, 4 shorter ones on each side and a few others still shorter; meso- and metanotum with 2 long submedial setae on the praescutum, 3 very long setae, 2 shorter ones and a few still shorter on each side of scutum. Legs: tarsus twice as long as praetarsus with 3 + 3 setae below; hind claw about twice as long as front claw, median claw small but well developed. Abdomen: tergite I. with a pair of fairly submedian praescutal setae and a pair of rather long submedian subposterior scutal setae; tergite II. with a pair of rather short submedian praescutal setae and 3 long, 3 short and a few shorter setae on each side of the scutum; III.-VII. with 6 long, 3 short and some shorter setae on each side; VIII. with 4 long setae on each side; postero-lateral angles of tergites V.-VI. rounded, VII. produced in a short finger-like process, VIII. rounded. First abdominal sternite as figured. Stylets and vesicles normal. Segment X.

of abdomen about one-third longer than wide, very slightly tapering behind, lateral carinae indistinct, with one median subanterior seta, 6 long setae and other short and still shorter ones on each side. Forceps symmetrical, each arm with a large praemedial tooth, between this and the base with 2-3 small rounded tubercles, and postdentally with 10 gradually diminishing tubercles. Length of animal, 7-8 mm.

Holotype and *allotype* from Pinjarra, West Australia, September 28, 1931, collected by Mr. Swan. Another example was taken at Goyamin Pool, Chittering, West Australia, by Mr. Swan on October 19, 1931, and I found one myself at Kelmscott, West Australia, in 1932. Two more were collected by Prof. Nicholls at Armadale, West Australia, in June, 1932.

The relationships of this species to others of the genus are best given by the key.

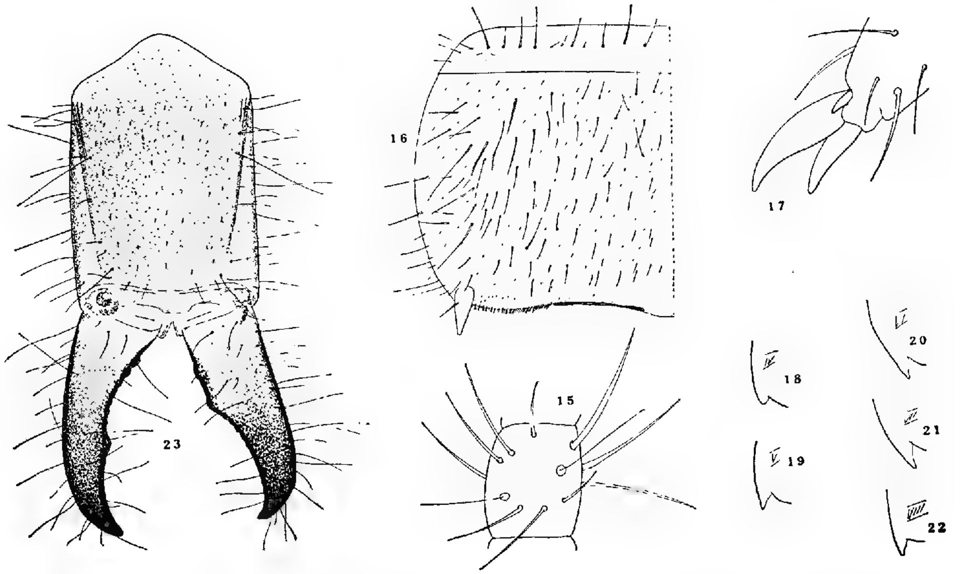


Figs. 11-14.
Japyx westraliense, n. sp.—11, subcoxal organ of first abdominal sternite; 12, foot; 13, tergite VII.; 14, abdominal segments VIII.-X. and forceps from above.

Japyx glauerti, n. sp.

Description.—Colour, deep yellowish cream, considerably darker on abdominal segments VIII.-X., and still more so on forceps, especially towards the tips. Head: antennae 42 segmented, sensory hairs on IV.-VI. as in other species. Abdominal tergites with the postero-lateral angles produced in IV.-VIII., as figured. Tarsal claws as in other species *(cf.* fig.). Subcoxal organ on first abdominal sternite as figured. Abdominal segment X. slightly longer than wide with distinct lateral carinae. Forceps longer than segment X., asymmetrical, left arm with a postmedian tooth, between this and the base with $\frac{3}{8}$ teeth gradually diminishing towards large tooth, the basal ones being rather flattened, postdentally the inner edge of arm is crenulate; right arm with large praemedian tooth, between this and the base with a single rather large tubercle, from tooth to apex strongly concave with 13 to 14 tubercles gradually diminishing into crenulations. Length of animal, 28 mm.

Type.—A single specimen collected by Mr. L. J. Glauert, of the Perth Museum, at the Serpentine Falls, West Australia, in 1925.



Figs. 15-23.

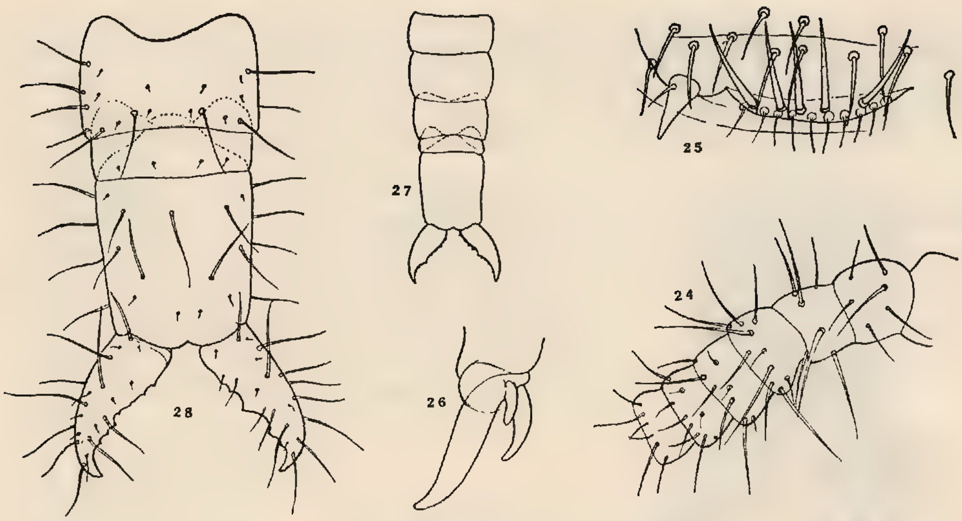
Japyx glauerti, n. sp.—15, segment IV. of antennae, showing sensillae; 16, left half of sternite I., showing subcoxal organ; 17, foot; 18-22, postero-lateral corners of tergites IV.-VIII., respectively; 23, segment X. and forceps from above.

Japyx nichollsi, n. sp.

Description.—Colour: white, segment X. lightly yellow, forceps a little darker. Head: a little longer than broad, with 16 long setae and a few shorter ones on each side; antennae 26 segmented, III. longer than broad with setae 0·35 mm. long, IV.-VI. with the usual sensory setae but these are relatively short and thick, X. broader than long, ultimate and penultimate segments not longer than broad. Maxillary palpi normal with 4 pectinate inner lamellae and inner process. Labial palpi elongate 60 μ. long by 20 μ. wide. Pronotum with 3 very long setae and 4 shorter ones on each side; meso- and metanotum with a pair of fairly long submedial praescutal setae, with 4 very long and 6 shorter and many minute setae on each side, and with only minute postscutal setae; tergite I. with 1 long and 4 short setae, tergite II. with 3 long, 2 short and 5 shorter setae on each side, III.-VII. similar, VIII. with 3 long and a few minute ones on each side, X. with 1 long medial subanterior seta and 6 long setae on each side. Legs and claws normal (*cf.* fig.). First abdominal sternite with subcoxal organ, as figured. Forceps subequal to segment X. in length, asymmetrical, left arm with only moderately large postmedial tooth, between it and the base with sinuous inner margin and five small acute teeth the basal two of which are somewhat longer than the others, postdentally with two small acute teeth; right arm with large slightly postmedial tooth, praedentally with 3 acute teeth, postdentally with one small acute tooth and one rounded tubercle. Length of animal, 5 to 6 mm.

Syntypes.—Five specimens collected by Prof. Nicholls and his students at Frankland River, South-West Australia, in January, 1933.

Remarks.—While this species is definitely distinct from all others none of the specimens were completely mature, all lacking genital organs.



Figs. 24-28.

Japyx nichollsi, n. sp.—24, first seven antennal segments; 25, subcoxal organ of first sternite; 26, foot; 27, abdominal segments VI.-X. with forceps; 28, abdominal segments VIII.-X. and forceps more enlarged.

Genus Heterojapyx Verhoeff., 1904.

The main character separating this genus from others is to be found in the structure of the tarsi. At the base of each claw is a short, stout conical process or empodium. The species of *Heterojapyx* are also, as a rule, of much greater size but, apart from the dentition of the forceps, few specific distinctions are to be found.

Heterojapyx novae-hollandiae Verhoeff.

I have before me a specimen of this species collected by Mr. E. S. Gourlay on Dun Mountain, Nelson, New Zealand, on November 29, 1927, at 2,000 feet. It

Fig. 29.

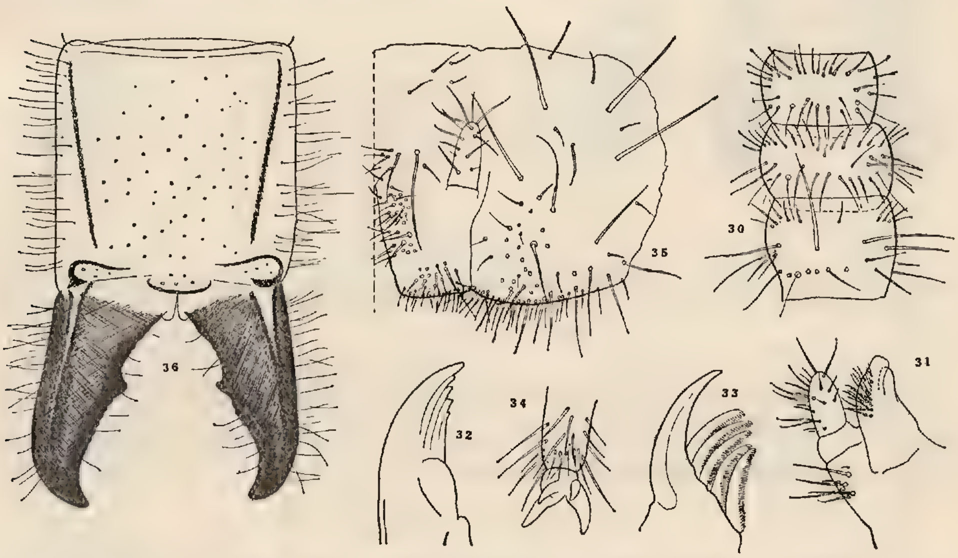
Heterojapyx novae-hollandiae Verh. Forceps.

was given to me by Mr. J. W. Evans. Two other specimens were also sent to me by Mr. Gourlay, labelled Nelson, New Zealand, February 22, 1933.

In all three examples the large praemedial tooth of the left arm of the forceps is not acute, as shown in Silvestri's figure, but broad and flattened *(cf.* fig.).

Heterojapyx evansi, n. sp.

Description.—Colour, deep honey yellow, segment X. almost reddish and forceps almost black. Head about as long as wide. Antennae 40-segmented, segments IV.-XIII. with 3-4 sensillary setae, these as long as the ordinary setae. Mandibles strong, with 5 teeth. Maxillae with internal and external lobes as figured. Abdomen: all tergites with their postero-lateral angles rounded. Subcoxal organ of first abdominal sternite as in other species. Legs short and robust, claws as figured. Stylets and vesicles normal. Segment X. slightly longer than wide, with distinct lateral carinae. Forceps very slightly shorter than segment X., with only one large praemedial tooth on each arm, before and after this tooth with a number of small rounded teeth or tubercles. Length of animal, 25-35 mm.



Figs. 30-36.
Heterojapyx evansi, n. sp.—30, segments II.-IV. of antennae; 31, external lobe of maxilla; 32, mandible; 33, internal lobe of maxilla; 34, foot; 35, right half of male genital organ showing appendage; 36, forceps and abdominal segment X.

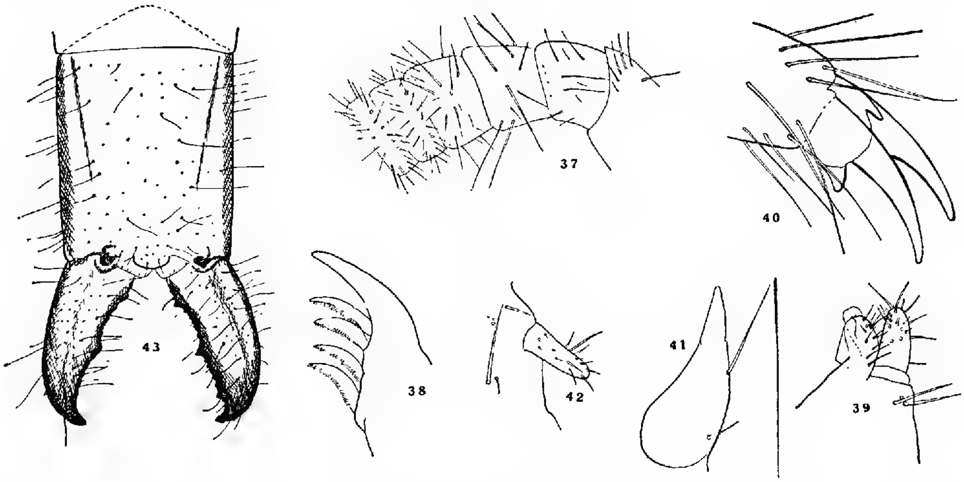
Type collected by Mr. J. W. Evans at Condor Creek, F. C. T., in October, 1929. Three other specimens are from Mount Kosciusko, F. C. T., in December, 1929, collected by Dr. R. J. Tillyard.

Remarks.—This species is very closely related to *H. victoriae* Silv., but the latter has two large teeth on each arm of the forceps.

Heterojapyx tambourinensis, n. sp.

Description.—Colour of a deep creamy yellow, segment X. almost reddish, forceps still darker. Head slightly longer than broad. Antennae 44-segmented with 3-4 sensory setae on segments IV.-XIII., these setae as long as the ordinary setae. Mandibles strong, with 5 teeth. Internal and external lobes of the maxillae, as figured. Labial palpi elongate 30 μ. by 90 μ. *(cf.* fig.). Legs short and robust, with claws as figured for preceding species. Abdomen with all tergites rounded at postero-lateral corners. Subcoxal organ of first sternite as in other species.

Stylets and vesicles normal. Segment X. of abdomen about as long again as wide and much longer than the forceps, with distinct lateral carinae. Forceps asymmetrical, left arm with two large teeth, the first sub-basal, the second praemedial; right arm with three large teeth, one sub-basal, one postmedial and one sub-apical. Length of animal, 28 mm.



Figs. 37-43.

Heterojapyx tambourinensis, n. sp.—37, basal antennal segments; 38, internal lobe of maxilla; 39, external lobe of maxilla; 40, foot; 41, stylet; 42, male genital appendage; 43, forceps and abdominal segment X.

The *type* is from Mount Tambourine, Queensland, collected by Mr. A. M. Lea; whilst the second specimen is from Sydney, also collected by Mr. Lea. In neither case is a date given. Both specimens were found in the South Australian Museum collections, mounted dry, on cards.

Genus Parajapyx Silv.

This genus, together with *Ectasjapyx* Silv., differs from all others in the entire absence of sensory setae on the antennae. The body is elongate and the exsertile vesicles are very large. The forceps are short and stout. In *Parajapyx*, segment IX. of the abdomen is shorter than either VIII. or X.; in *Ectasjapyx* these are equally long.

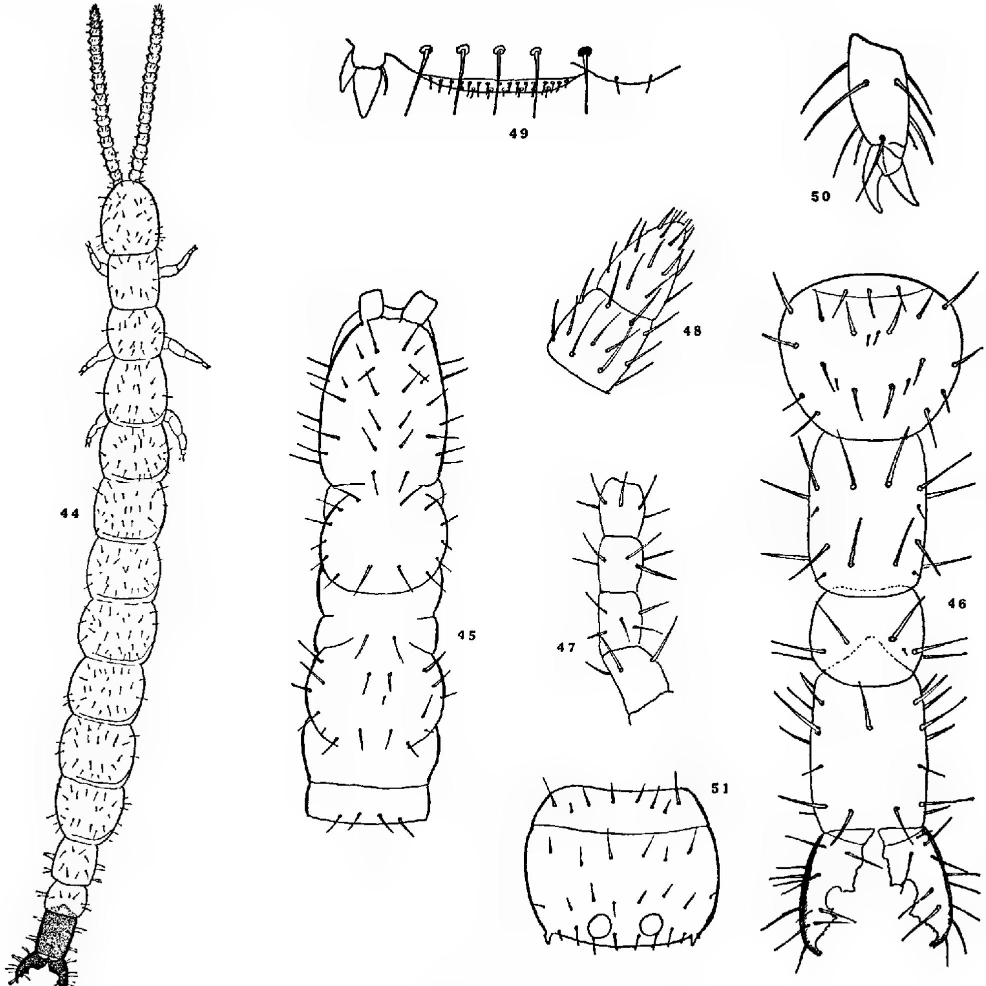
No species of this genus has previously been recorded from Australia, although *Parajapyx samoanus* was described by Silvestri from Samoa. The following new species is very distinct from *P. samoanus* Silv.

Parajapyx swani, n. sp.

Description.—Colour of a creamy yellow, only the forceps a little darker. Head with approximately 15 setae on each side above. Antennae 18-segmented, with the setae as figured. Thorax: pronotum with 7, meso- and metanotum with 10 setae on each side. Legs with tarsus shorter than praetarsus, median claw short, lateral claws subequal. Abdomen: first sternite with subcoxal organ, as figured. Stylets and exsertile vesicles normal. Segment VIII. about twice as long as IX. and as long as X., the last without lateral carinae. Forceps short and stout, symmetrical, with a very long indentation medially and a large tooth on each side of this indentation, the basal portion of the inner edge is almost straight

with a rather large rounded tooth proximally and then several small serrations, the distal portion of inner margin sinuate. Length of animal, 3-4 mm.

Syntypes.—Four specimens from Pinjarra, West Australia, September, 1931, collected by Mr. Swan; other examples from Kelmscott, West Australia, September, 1932 (H. W.), Glen Osmond, South Australia, in garden soil, October, 1929 (J. D.), April, 1932 (D. C. S.), and March, 1933 (H. W.).



Figs. 44-51.

Parajapyx swani, n. sp.—44, dorsal view of entire insect; 45, head and thorax I. and II. from above, more enlarged; 46, segments VII.-X. and forceps from above more enlarged; 47, basal antennal segments; 48, two apical antennal segments; 49, subcoxal organ on first abdominal sternite; 50, foot; 51, abdominal segment from below showing vesicles.

KEY TO THE AUSTRALIAN SPECIES OF *JAPYX.*

1. Segment X. of abdomen with distinct lateral carinae. 4
   Segment X. of abdomen without distinct carinae. 2
2. Forceps asymmetrical. 3.
   Forceps symmetrical. Antennae 24-segmented. Length, 7-8 mm. Tergites V. and VI. rounded, VII. strongly produced at postero-lateral corners. Each arm of forceps with one large praemedial tooth. *J. westraliense,* n. sp.

3. Antennae 32-segmented. Length of animal, 7-8 mm. Tergite V. slightly, VI. and VII. more produced at postero-lateral corners. Left arm of forceps with a large median tooth, and right arm with a large praemedian tooth. *J. froggatti* Silv.

   Antennae 26-segmented. Length of animal, 5-6 mm. Tergites V., VI., and VII. rounded at postero-lateral corners. Left arm of forceps with postmedial tooth; right arm with large slightly postmedial tooth. *J. nichollsi*, n. sp.

4. Large species, 28 mm. Antennae 42-segmented. Forceps asymmetrical, left arm with large postmedian tooth and some fairly large proximal teeth; right arm with large praemedian tooth and a rather large tubercle proximally, from tooth to apex the margin is strongly concave. Tergite IV. slightly produced at the postero-lateral corners, V. strongly and acutely so, VI. and VII. more so, VIII. as in V. *J. glauerti*, n. sp.

   Small species not exceeding about 15 mm. 5

5. Antennae 41-segmented. Length of animal, 15 mm. Tergite VI. scarcely produced at postero-lateral corners, VI. strongly produced. Forceps asymmetrical, left arms without large tooth and narrower than right arm; right arm with a large tooth at about one-third from base. *J. longiseta* Silv.

   Antennae with fewer segments. 6

6. Antennae with 30 segments. Length of animal, 13 mm. Forceps asymmetrical, left arm with large postmedian tooth; right arm with large praemedian tooth. Tergite V. slightly, VI. slightly, and VII. somewhat more produced at postero-lateral corners. *J. leae* Silv.

   Antennae with fewer segments. 7

7. Antennae with 28 segments. Length of animal, 7 mm. Forceps asymmetrical, left arm with large tooth beyond middle, right arm with large praemedian tooth. Tergite V. rounded, VI. shortly, and VII. largely produced at postero-lateral corners. *J. michaelseni* Silv.

   Antennae with 26 segments. 8

8. Length of animal, 8 mm. Forceps asymmetrical, left arm with large postmedial tooth, right arm with large praemedian tooth. Tergite V. rounded, VI. slightly, and VII. more produced at postero-lateral corners. *J. tillyardi* Silv.

   Length of animal, 8 mm. Forceps asymmetrical, left arm with strongly sinuate inner margin without large tooth, right arm with large submedian tooth. Tergite V. rounded, VI. slightly, and VII. more produced at postero-lateral corners. *J. mjöbergi* Silv.

KEY TO THE AUSTRALASIAN SPECIES OF *HETEROJAPYX*.

1. Forceps symmetrical. 2

   Forceps asymmetrical. 3

2. Forceps with only a large praemedian tooth on each arm. Antennae 40-segmented. Length of animal, 25 mm. *H. evansi*, n. sp.

   Forceps with two large teeth on each arm, one praemedial and one postmedial. Antennae 39-segmented. Length of animal, 38 mm. *H. victoriae* Silv

3. Left arm of forceps with a fairly large tooth near the base. 4

   Left arm of forceps with only a praemedian large tooth. Antennae 39-segmented. *H. novae-hollandiae* Verh.

4. Second large tooth of left arm of forceps median in position; right arm with a sub-basal, a slightly postmedial and a subapical large tooth. Antennae 44-segmented. Length of animal, 28 mm. *H. tambourinensis*, n. sp.

   Second large tooth of left arm of forceps praemedian in position; right arm with 4 large teeth, one sub-basal, one at one-fourth from base, one postmedial, and one subapical. Antennae? Length of animal, 30-50 mm. *H. gallardi* Till.

Bibliography.

1. Silvestri, F. 1901—Materiali per lo studio dei Tisanuri, ii. Specie di *Japyx* conservate nello mia collezione. *Boll. Soc. ent. ital.,* **vol. xxx.,** pp. 212-223.
2. „ „ 1904—Thysanura in "Fauna Hawaiiensis," **vol. iii.,** pp. 295-7.
3. „ „ 1908—Thysanura, Japygidae, in "Die Fauna Südwest-Australiens," **vol. ii.,** pp. 47-68.
4. „ „ 1910—Materiali per lo studio dei Tisanuri, xv., Nova specie di Heterojapyx dell' Australia. *Boll. Lab. Zool.,* Portici., **vol. v.,** pp. 97-99.
5. „ „ 1928—Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia, 1910-13, xlviii., Thysanura, Japygidae. *Arkiv. f. Zool.,* Bd., 20A, No. 9, pp. 1-4.
6. „ „ 1930—Contribuzione all conoscenza degli Japygidae (Thysanura) della regione Australiana. *Boll. Lab. Zool.,* Portici, **vol. xxiii.,** pp. 210-226.
7. Tillyard, R. J. 1924—Primitive wingless insects, pt. i., The Silver Fish, Bristlestails and allies. *New Zealand Jour. Sci. & Tech.,* **vol. vii.,**
8. „ „ 1926—In "Insects of Australia and New Zealand," Sydney.

SINGLE VALUE CLIMATIC FACTORS.

BY J. A. PRESCOTT

Summary

In the study of the relationship between climatic conditions and the geographical distribution of plants and animals and of soils, numerous attempts have been made to secure correlations between such distributions and single value functions of the weather which have been deemed most appropriate or most efficient. Mean annual values for temperature and for rainfall are the most familiar examples of such single values, but these are not in themselves generally considered by most workers to be efficient measures of climatic conditions when anything more than a limited area is under consideration.

SINGLE VALUE CLIMATIC FACTORS.

By J. A. Prescott,
Waite Agricultural Research Institute, The University of Adelaide.

[Read May 10, 1934.]

In the study of the relationship between climatic conditions and the geographical distribution of plants and animals and of soils, numerous attempts have been made to secure correlations between such distributions and single value functions of the weather which have been deemed most appropriate or most efficient. Mean annual values for temperature and for rainfall are the most familiar examples of such single values, but these are not in themselves generally considered by most workers to be efficient measures of climatic conditions when anything more than a limited area is under consideration.

It is the purpose of the present paper to enumerate and examine, so far as the original literature has been available, the various attempts that have been made in this direction, and to discuss their mutual relationships and probable relative efficiencies for the purpose under consideration. Only those single values relating to moisture conditions or rainfall efficiency will be considered.

The essential principle of all the methods adopted has been to correct for the decreasing efficiency of rainfall under rising temperature by means of a function involving both rainfall and temperature. In another series this correction is applied through an estimate of the evaporation either directly from evaporimeters or through some function of the water vapour pressure of the atmosphere related to evaporation which could be determined from observations on temperature and relative humidity.

Precipitation-temperature Ratios.

The first attempt in this direction is that of Lang (1915), who was primarily concerned with possible temperature and rainfall limits of soil zones having a recognised geographical distribution. The Lang factor $\frac{P}{T}$ (where P is expressed in millimetres and T in degrees centigrade) has not been extensively applied, its place having been taken by other factors with temperatures at different zero points.

In the "index of aridity" of de Martonne (1926), the zero point is taken at –10°C., which was determined by de Martonne and Aufrère (1925) as being most in accord with the observed proportional distribution of areas of internal drainage over the earth's surface. This index $\frac{P}{T + 10}$ has been used by de Martonne himself in defining the climatic limits of deserts, prairies, and forests, and has been used in relation to Australia by Andrews and Maze (1933), who observe that this index gives a satisfactory general impression of the conditions which prevail. Perrin (1931) and Andrews and Maze (1933) have further discussed the monthly values of this index, the former in relation to forest types and the latter in relation to aridity. Perrin observes that the factor does not apply well to cool zones owing to high values in the cold months, with an infinitely high value at –10°C. Andrews and Maze assume that a monthly index of 1 is a significant indication of the condition of aridity, and plot the number of months of the year with an arid period, in itself a new single value. This method of enumerating those months of the year having some characteristic climatic ratio is of some

considerable promise and has been further applied by Davidson (1933, 1934), who has determined the months of the year in which rainfall exceeds the estimated evaporation.

Emberger (1930) further investigated the application of the factor of de Martonne, particularly in relation to Mediterranean climates, and found a more satisfactory ratio in the expression,

$$\frac{100}{2} \times \frac{P}{\left(\frac{M+m}{2}\right)(M-m)}$$

where M = the mean maximum temperature of the warmest month and m the mean minimum temperature of the coldest month, the expression M — m serving, therefore, as an index of continentality, and, according to Emberger, of evaporation

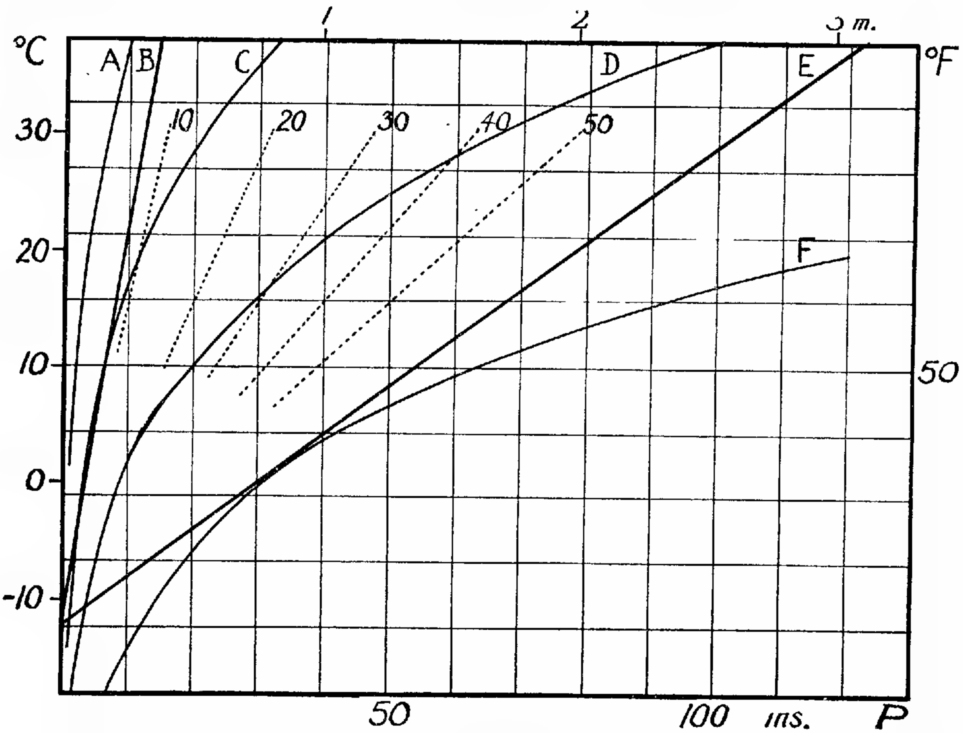


Fig. 1.

Showing the relationship between temperature and precipitation for constant precipitation-evaporation ratios.

P/E = 0·1.
- A for 80% relative humidity.
- B Thornthwaite's value.
- C for 30% relative humidity.

P/E = 1·0.
- D for 80% relative humidity.
- E Thornthwaite's value.
- F for 30% relative humidity.

The broken lines indicate indices of aridity according to de Martonne's formula $\frac{P}{T+10}$.

The ratio E = 260 s.d. has been assumed in curves A, C, E, and F.

In seeking for a similar relationship with respect to the distribution of soil types in Quebec, McKibbin (1933) found it necessary to disregard conditions in

the winter five months where the ground was frozen, and to measure both rainfall and temperature as monthly means from selected base values, 2 inches in the case of rainfall and 52°F. in the case of temperature. McKibbin's ratio, therefore, becomes $\dfrac{P-2}{T-52}$ expressed in inches of rain and in degrees Fahrenheit, considering only the growing season of seven months. The base value 2 for rainfall is selected from the lowest average monthly rainfall recorded for any observation point within the area under consideration, and similarly the lowest mean monthly temperature is selected as the temperature base.

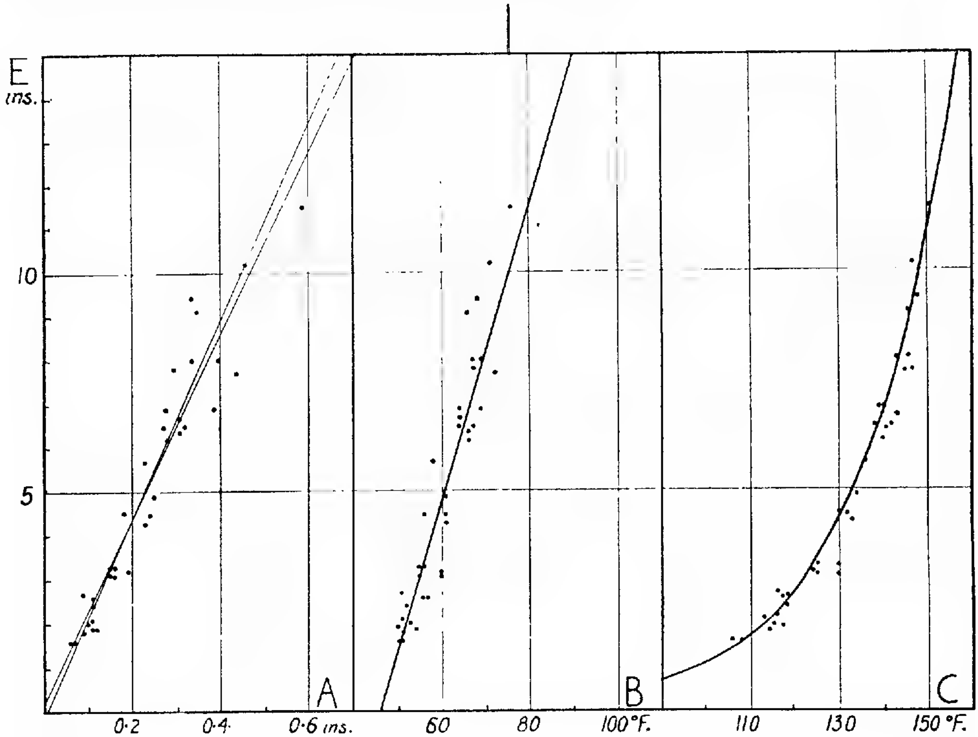


Fig. 2.

Showing the relationship between the evaporation from a free water surface at the Waite Institute for 36 consecutive months, and A, saturation deficiency; B, mean temperature; and C, solar maximum temperature.

In 2A, the two regression lines relating E and s.d. have been drawn. In 2B, the point of intersection with the temperature axis is 46°F. corresponding to the mean dew point. The curve in 2C is calculated from the relationship log $E = k.T$, and the curve illustrated fits the mean monthly data for the capital cities reasonably well.

Precipitation-evaporation Ratios.

All climatic factors involving estimates of evaporation go back to the work of Transeau (1905) who suggests the factor P/E, utilizing for this purpose the evaporation data collected by Russell (1888) during the season 1887-1888. This ratio is ideal in many ways in that the units of rainfall and evaporation are the same, namely inches or centimetres of water, and was regarded by Livingstone and Shreve (1921) "as the nearest approach as yet possible towards an ideal index of the external moisture-relation of plants."

This opinion of Livingstone and Shreve led Szymkiewicz to a fuller study of the subject, which resulted in an extended series of papers in the Records of the Botanical Society of Poland extending from 1923 to 1930. Szymkiewicz pointed out that in accordance with Dalton's Law (1798) the intensity of evaporation is proportional to the difference between the vapour tension at the evaporating surface and that of the surrounding air, or in other words, was principally dependent on the vapour tension deficit (deficit hygrometrique, Sättingungs-deficit), and that the use of this climatic constant was more satisfactory than evaporation records insofar as these were dependent on the form of the evaporimeter as well as on humidity, atmospheric pressure, wind velocity and insolation. The European literature on evaporation is extensively reviewed in this series of

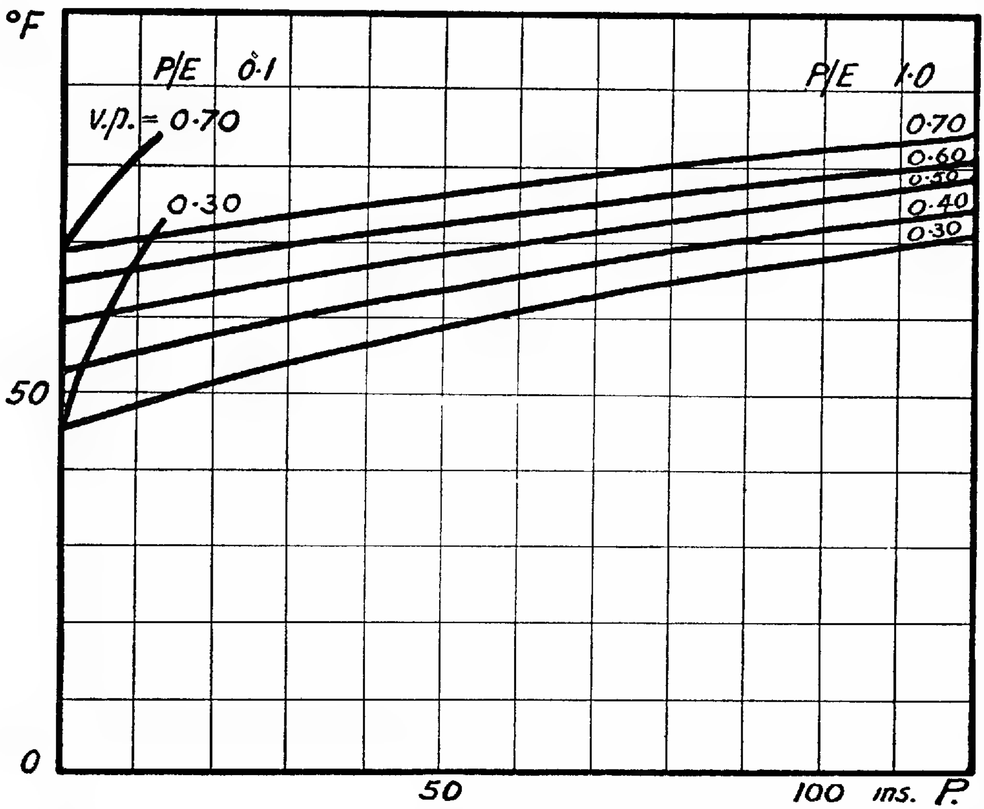


Fig. 3.

Showing the relationship between temperature and precipitation for constant precipitation evaporation ratios of 0·1 and 1·0, the water vapour pressure of the atmosphere remaining constant at the given values ranging from 0·30 to 0·70.

papers, and Szymkiewicz develops the concept of index of evaporation to replace actual evaporimeter measurements. In one of his first papers (1923) the index of evaporation is $i = \text{s.d.} \dfrac{(273 + t)^2}{273^2} \cdot \dfrac{760}{P - p}$,

where s.d. = vapour pressure deficit.
P = atmospheric pressure.
p = water vapour pressure.

This expression allows for the effect of temperature in raising the humidity at the surface of the evaporimeter. In a fifth paper (1925), starting from the work of Stefan (1871, 1874), he further considers the effect of diffusion on the rate of evaporation; his new index of evaporation becomes

$$i = \text{s.d.}\,\frac{273 + t}{273}\cdot\frac{760}{P - p}$$

In the calculation of saturation deficit he suggests that this should be measured at the maximum temperature for each day, the mean value for each day being

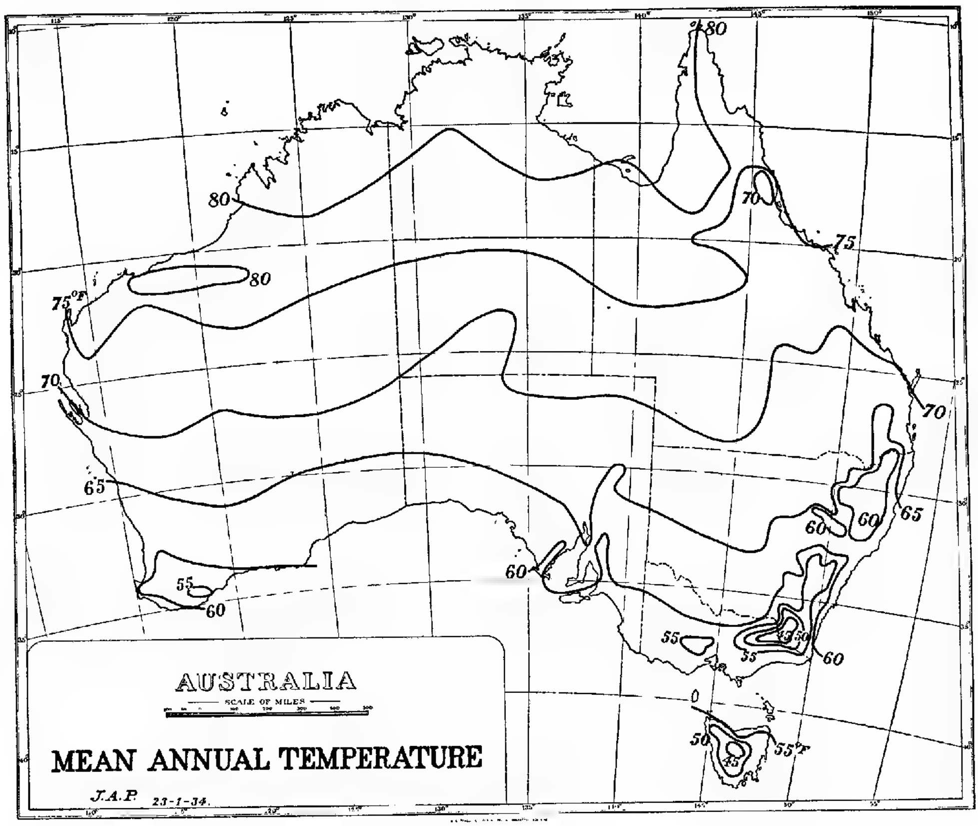


Fig. 4.

very nearly half that observed at the maximum temperature. As an annual index of evaporation he takes the sum of these mean monthly maxima and develops the

Hygrometric coefficient $Q = \dfrac{P \text{ (in mm.)}}{I \text{ (in mm. Hg.)}}$ where $I = \Sigma i$. At the limit for steppe formation, $Q = 5$.

On the publication of de Martonne's paper (1926), Szymkiewicz returns to the question and points out that evaporation is not a linear function of temperature but, if anything, an exponential function, and that in any case only reasonable

agreement between his index of evaporation and this exponential function is to be observed.

Meyer (1926), in discussing the work of Szymkiewicz, called attention to the unduly complex nature of the index of evaporation of this author and recommended the simple ratio of rainfall to saturation deficiency P/s.d. In the original paper are given the values of this ratio both for the year and for the frost free period for 505 stations in Europe, North Africa and West Asia, while Jenny (1929) subsequently covered the United States in a similar manner. Meyer recognised that the ratio was inadequate in so far as it omitted to take account of atmospheric pressure and of wind velocity on evaporation, nor could it take into consideration the distribution of the rain, and such features as sunshine, fog or

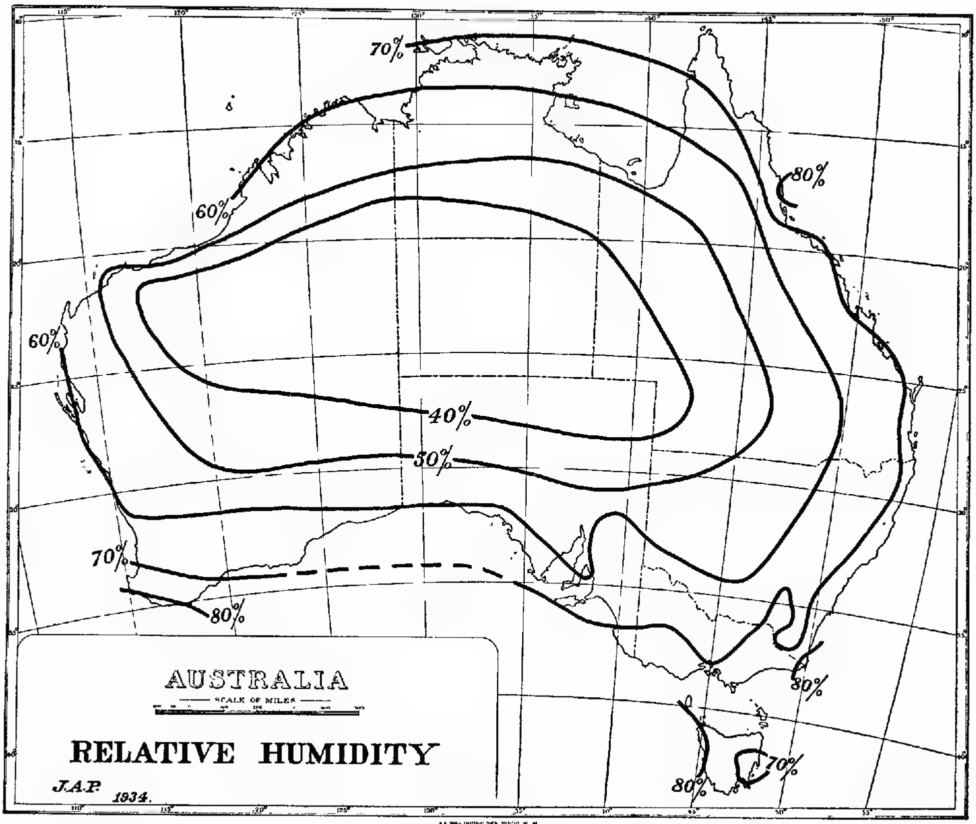


Fig. 5.

frost. In such a ratio one could only expect a clue to and not a complete expression of the connection between climate and soil.(1)

Thornthwaite (1931) has recently approached the subject again from the point of view of securing an expression for the P/E ratio, which could be obtained from a consideration of rainfall and temperature exclusively and a series of relationships between various monthly ratios of rainfall, evaporation and the temperature records for twenty-one stations in the western United States for the

(1) In the absence of access to the original paper, I am indebted to the Imperial Bureau of Soil Science for translated excerpts.

months April to September, inclusive. His analysis, which takes no account of relative humidity, results in an empirical relationship

$$\frac{P}{E} = 11 \cdot 5 \left(\frac{P}{T - 10} \right)^{\frac{10}{9}}$$

where P is in inches and T in degrees Fahrenheit. For the annual index, ten times the sum of the twelve monthly P/E ratios is taken.

Where values for relative humidity are available, this new relationship must be considered to be much inferior to the Meyer ratio.

In fig. 1 an attempt has been made graphically to depict the relationship found by Thornthwaite in relation to the ratio of de Martonne and to the actual precipitation evaporation ratios calculated from temperature and humidity considerations. The zero point + 10°F. is so close to de Martonne's (+ 14°F. — -10°C.) that the expression $\frac{P}{T - 10}$ in the above equation is practically identical with the $\frac{P}{T + 10}$ of de Martonne. The lines B and E represent Thornthwaite's values for P/E ratios of 0·1 and of 1·0, respectively, while the

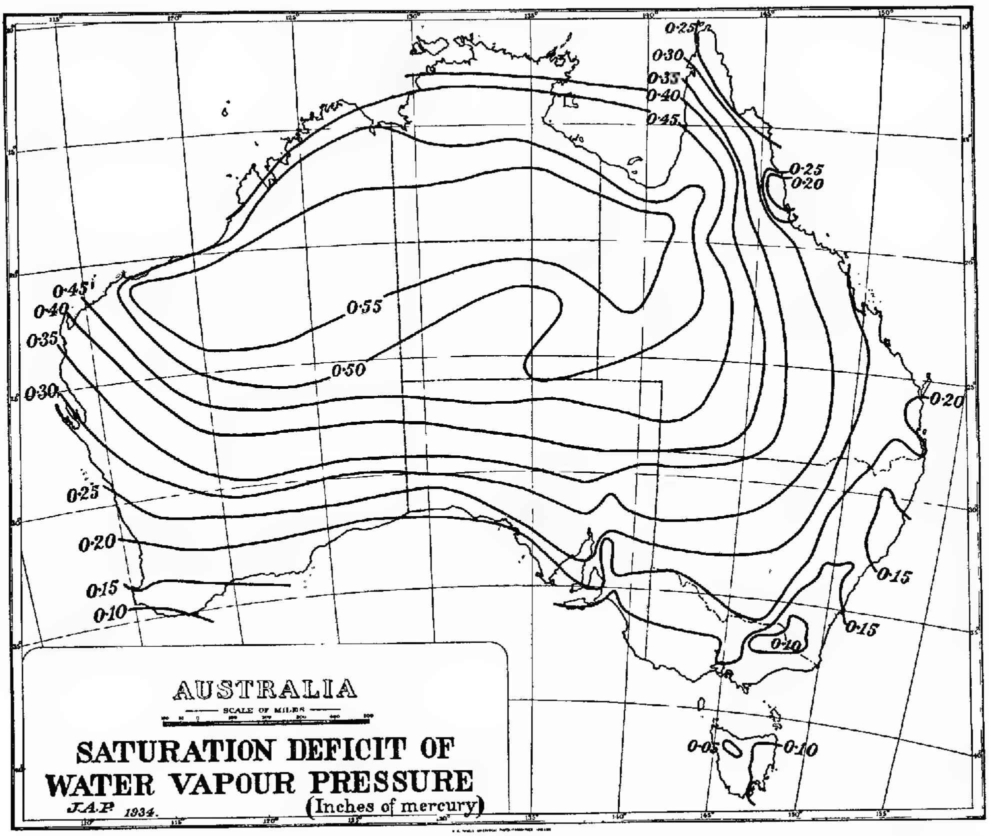


Fig. 6.

lines A and C, D and F, represent the corresponding theoretical lines for these ratios for relative humidities of 30% and 80%, the Australian limits for the mean

annual values. The broken lines marked 10 to 50, respectively, are the de Martonne ratios.

Saturation Deficiency as an Index of Evaporation.

As has already been pointed out, the fact that the evaporation from the surface of a liquid is proportional to the deficiency from saturation of the vapour pressure above that liquid was first enunciated by Dalton, and may be regarded as an established physical law.

Wherever the mean saturation deficiency can be calculated as a meteorological constant, it is obviously much more efficient than temperature alone as an index of the evaporating power of the atmosphere, and should be utilized whenever possible. The two observations required are temperature and relative humidity, and it is usually the doubt with regard to the accuracy of the latter value that has made most workers hesitate to calculate the water vapour pressure of the atmosphere or the saturation deficit of this vapour pressure. It is generally accepted that the mean temperature as represented by $\frac{\text{Maximum} + \text{Minimum}}{2}$ is a satisfactory measure of temperature so far as annual and monthly values are concerned. The Australian meteorological service has chosen the 9.0 a.m. reading of relative humidity as representing the mean for the day, and while this is not always true so far as individual days are concerned, it is very nearly true when a period even so short as one week is considered.

In order to confirm this assumption, five weeks were taken at random during 1933 and the hourly values of relative humidity taken from the hygrograph records. The comparison between the values at 9.0 a.m. and the mean values is given in Table I., and a satisfactory agreement is to be noted.

Table I.

Comparison of mean hourly values for relative humidity with those for 9.0 a.m. (Hygrograph readings, Waite Institute).

Week Ending	9 a.m. Readings, %.	Mean Hourly Readings, %.
February 6, 1933 - - - -	57·3	56·3
April 24, 1933 - - - -	82·1	81·2
July 17, 1933 - - - -	88·0	92·4
October 23, 1933 - - - -	52·1	53·7
January 1, 1934 - - - -	48·7	54·8
Mean - -	65·6	67·7

The values for relative humidity at Australian stations recently published can, therefore, be used with confidence as satisfactory estimates for the calculation of saturation deficiency.

At a number of Australian stations, in recent years, records of evaporation from a free water surface have been obtained, using tank evaporimeters three feet in diameter. The records from such tanks have not yet been collected and critically co-ordinated, but the working data collected by the author from various sources are worthy of discussion at the present stage. Apart from the values published in the Commonwealth Year Book, reports of the irrigation authorities in Queensland and New South Wales are the principal sources of information.

These annual evaporimeter records and relevant data are given in Table II.

TABLE II.

Mean annual evaporation from a free water surface at Australian stations.

Station.	Evaporation (E) (Inches).	Mean Temperature ° F.	Mean Relative Humidity 9 a.m. %.	Saturation Deficit (s.d.) Inches of Mercury.	$\frac{E}{s.d.}$
QUEENSLAND.					
Brisbane - -	56	68·9	68	0·22	254
Blackall - -	86	72·4	50	0·40	215
Charleville - -	70	70·0	48	0·38	185
Home Hill - -	72	74·1	67	0·28	257
Warwick - -	56	63·5	66	0·20	280
Rockhampton - -	52	73·1	67	0·28	186
St. George - -	71	68·9	56	0·31	229
Winton - -	98	75·5	45	0·50	196
Boulia - - -	123	75·4	38	0·55	223
NEW SOUTH WALES and F.C.T.					
Sydney - - -	39	63·2	70	0·17	229
Griffith - -	58	62·5	63	0·21	276
Leeton - - -	51	62·2	61	0·21	242
Burrinjack - -	36	58·0	69	0·15	240
Wentworth - -	62	63·8	63	0·21	296
Dubbo - - -	66	63·7	64	0·21	314
Canberra - -	46	55·8	69	0·14	328
VICTORIA and TASMANIA.					
Melbourne - -	39	58·4	68	0·15	260
Rutherglen - -	51	60·1	67	0·17	301
Merbein - - -	67	62·0	67	0·19	352
Hobart - - -	32	54·3	68	0·13	246
SOUTH AUSTRALIA and N.T.					
Adelaide - -	55	63·0	53	0·27	204
Waite Institute -	62	61·3	66	0·19	327
Alice Springs - -	94	69·6	37	0·47	201
WESTERN AUSTRALIA.					
Perth - - -	66	64·2	63	0·21	314
Kalgoorlie - -	88	65·9	57	0·28	314
Coolgardie - -	84	64·5	54	0·28	300
				Mean -	259

The improvement in the relationship obtained by allowing for wind velocity has already been indicated by Davidson (1933).

In plotting these data, the most satisfactory correlation on inspection is that between evaporation and saturation deficit; that between evaporation and temperature is not so satisfactory.

THE RELATIONSHIP BETWEEN EVAPORATION AND METEOROLOGICAL FACTORS AT THE WAITE INSTITUTE.

For the thirty-six consecutive months, January, 1931, to December, 1933, corresponding to a period when wind velocity records were first available, the

relationship between climatic factors and the evaporation from a free water surface at the Waite Institute has been statistically investigated. The evaporimeter is the standard Australian tank, three feet in diameter. In fig. 2 are plotted the relationship between the total monthly evaporation and the mean saturation deficiency, mean temperature and mean solar maximum temperature. The correlation coefficient between evaporation and saturation deficiency is 0·96, and the corresponding regression lines are given in the diagram. Between mean temperature and evaporation the correlation is from inspection if anything rather higher, evaporation reaching its zero point at 46°F., corresponding to the dew point of the average water vapour pressure during this period, of 0·31 inches. The range of vapour pressure was from 0·24 to 0·37, corresponding to dew points of 39°F. and 51°F.

In the case of solar maximum temperature the correlation is even greater, the logarithm of the evaporation bearing a linear relationship to the solar maximum temperature which tends to be high in relation to the mean temperature when the vapour pressure is low.

The wind factor varies in these records from 2·1 to 6·0 miles per hour with a mean at 3·9. The range is rather small and the wind velocity is higher in winter than in summer, so that in all the statistical significance is less satisfactory.

The statistical examination of the records yields the following correlations:—

Evaporation to saturation deficiency - -	0·958
Evaporation to wind velocity - - -	0·746
Wind velocity to saturation deficiency - -	0·657
Evaporation to saturation deficiency (after eliminating wind) - - - -	0·932
Evaporation to saturation deficiency x wind -	0·966

The standard equation relating evaporation to wind velocity is of the form:—

$$E = (k - lB)\ (m + nW)\ \text{s.d.}$$

where E = evaporation for 24 hours,
B = barometric pressure,
W = wind velocity in miles per hour,
s.d. = saturation deficiency,
and k, l, m, n are constants.

For conditions corresponding to those at the Waite Institute, American workers have usually adopted the formula $E = (0{\cdot}5 + 0{\cdot}05W)$ s.d., which at the mean wind velocity value of 3·9 would give $E = 0{\cdot}69$ s.d., whereas the regression equation calculated from the above data gives the practically identical value, $E = 0{\cdot}0085 + 0{\cdot}68$ s.d.

The regression equation of this form calculated from the above 36 values at the Waite Institute is:—

$$E = 0{\cdot}84 + (7{\cdot}66 + 2{\cdot}45W)\ \text{s.d. for the monthly values,}$$
$$\text{or } E = 0{\cdot}03 + (0{\cdot}25 + 0{\cdot}081W)\ \text{s.d. for the daily values,}$$

with a multiple correlation coefficient of 0·969.

The equation developed experimentally by Rohwer (1931) is $E = (0{\cdot}44 + 0{\cdot}118W)$ s.d., where the wind velocity and saturation deficiency are both measured at the surface of the water. This wind velocity is approximately 0·4 that of the standard anemometer reading at 30 feet above ground level.

It is evident that before a satisfactory formula can be developed for the standard Australian evaporimeter further work will be required.

Fig. 2B brings out an important fact which is generally overlooked in these discussions, that the real zero point for temperature in relation to evaporation is not the — 10°C. of de Martonne nor the — 10°F. of Thornthwaite, but the dew-point. This value will, of course, vary with locality, and from time to time. While the relative humidity varies enormously during the day, as a result of temperature changes, it is rarely realized how relatively constant remains the vapour pressure, and that only for localities with equal mean vapour pressures can an approximately linear relationship hold between evaporation and temperature. In fig. 3 have been demonstrated, in the same manner as in fig. 1, the lines

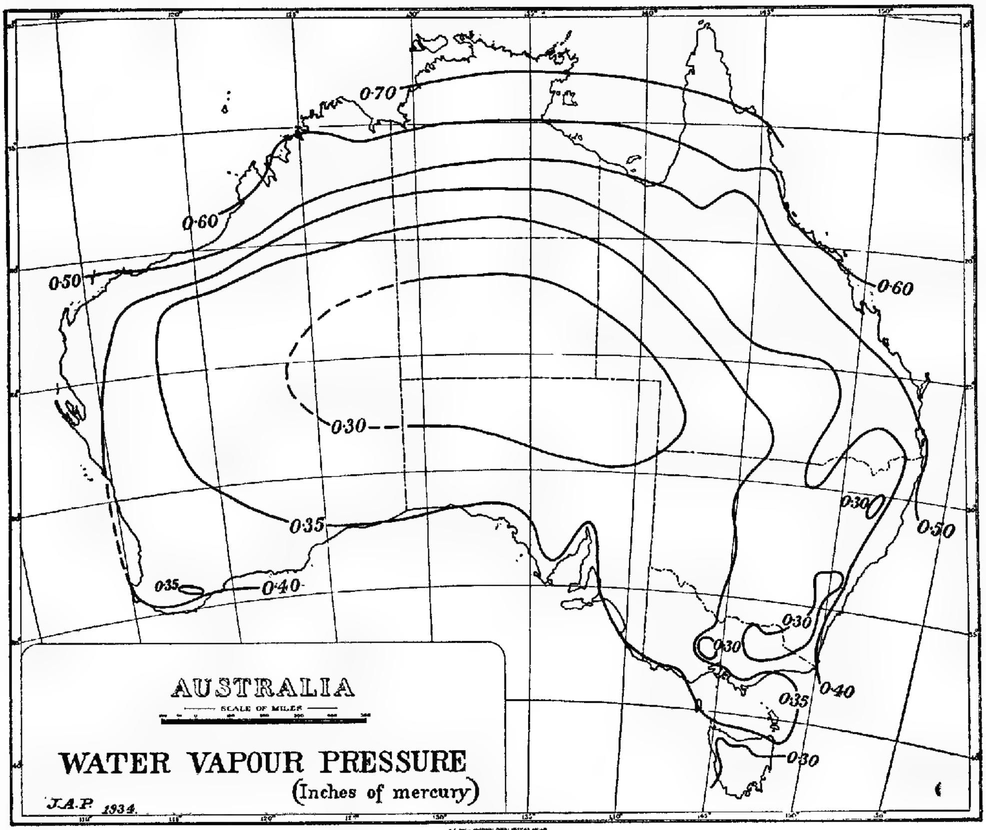


Fig. 7.

relating temperature and precipitation in cases where P/E = 0·1 and 1·0, respectively, and for vapour pressures corresponding to the Australian limits of 0·30 to 0·70 inches of mercury. Within limits these curves approximate to straight lines and represent the ideal relationship which de Martonne and his successors have been striving to attain. An examination of the map of Australia showing vapour pressure (fig. 7) shows that a large area of the continent most subject to study from the southern centres has a mean vapour pressure between 0·30 and 0·40, so that such a simple relationship might readily be established, but that once north of the Tropic of Capricorn this value rises rapidly and that independent relationships would be required. The approximately parallel character of these lines recalls Crowther's leaching factor (1930), in which a rise of 1°C. must be compensated for by 3·3 cms. of rain in order to maintain constant leaching conditions. This would correspond in the above diagram to a P/E ratio of approximately 0·2.

The Relationship between Single Value Climatic Factors and Vegetation.

The principal purpose of the evaluation of single value factors is naturally to give some quantitative expression to the degrees of humidity and aridity which have received qualitative recognition.

The relationships that have been determined can best be observed by reference to the following table:—

Table III.

Lang Factor P/T.		de Martonne P/T+10.		Thornthwaite P/E.		
Soil Zone.	Limits of Index.	Vegetation Zone.	Limits of Index.	Vegetation Zone.	Limits of Index.	Calculated to P/s.d.*
Podsols	160+		40	Rain Forest	128+	277+
Black Earths	100—160	Forests		Forest	64—128	177—277
Brown and Red Soils	40—100		30	Grassland	32— 64	89—177
Semi-desert and		Prairies	10	Steppe	16— 32	44—177
Steppe Soils	0— 40	True Deserts	below 5	Desert	0— 16	0— 44

* Assuming E = 260 s.d.

Meyer P/s.d.		P/s.d.	
Soil Zone.	Limits of Index.‡	Vegetation Zone	Observed Limits for Australia.
Podsols	400—1,000	High Moor	500—1,000
Brown Forest Soils	300— 450	Forests	200—1,000
Prairie Soils	260— 350	Savannah Woodlands	50— 200
Black Earths	130— 250	Arid Grassland	40— 50
Grey and Brown Soils	30— 170	Desert Steppe	18— 40
Desert Soils	0— 30	Desert	0— 18

‡ Includes also Jenny's estimates.

In the case of Australia, the values for actual rainfall and saturation deficit were actually entered along the boundaries between the vegetation association depicted on the author's vegetation map of Australia (1931). In practically all cases a reasonably satisfactory linear relationship between precipitation and saturation deficiency was observed along the whole boundary between any two given associations. This is further brought out by an inspection of the map illustrating the Meyer ratio (fig. 8). The Meyer ratio, or an alternative function including rainfall and saturation deficiency, therefore appears to offer an efficient measure of rainfall-evaporation relationships and to be worthy of further investigation.

Climatic Constants for Australia.

In view of the recent publication[2] of meteorological data for certain Australian localities, the opportunity has been taken to revise the various maps that have been published by the author in connection with previous studies (1931), and these are given in figs. 4 to 8. The principle adopted has been to enter at

[2] C.S.I.R. Pamphlet 42, 1933.

each locality on a blank map of Australia the relevant climatic constant. For temperature in each area the quantitative relationship between height above sea level and temperature was determined, so as to obtain satisfactory interpolations. In the case of saturation deficiency and vapour pressure, these were calculated for each station and entered on a map on which the temperature and relative humidity lines had also been projected. A similar method was employed in the case of the Meyer ratio. In view of the fact that further data for Australia are not likely to be available for some considerable time, the charts are presented in the hope that they may be of some service to other students of these problems.

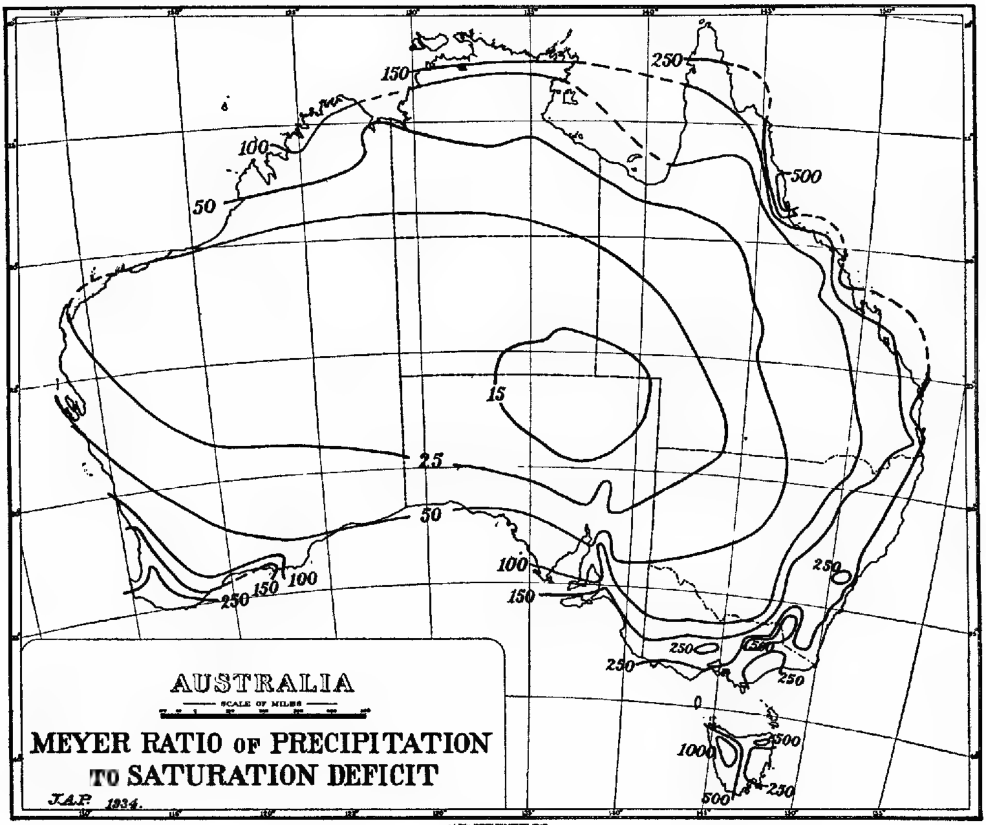


Fig. 8.

REFERENCES.

1. ANDREWS, J., and MAZE, W. H.—Proc. Linn. Soc., N.S.W., **vol. lviii.**, p. 105. 1933.

2. CROWTHER, E. M.—Proc. Roy. Soc. B., **vol. cvii.**, p. 1. 1930.

3. DALTON, J.—Mem. Manchester Lit. & Phil. Soc., **vol. v.**, p. 535. 1798.

4. DAVIDSON, J.—Aust. J. Expt. Viol., **vol. xi.**,, p. 59., 1933. Trans. Roy. Soc. S. Aust., **vol. lviii.**, pp. 58-61. 1934.

5. DE MARTONNE, E.—Comptes Rendus, **vol. clxxxii.**, p, 1,395. 1926.

6. DE MARTONNE, E., and AUFRÈRE, L.—Comptes Rendus, **vol. clxxx.**, p. 939. 1925.

7. EMBERGER, L.—Comptes Rendus, **vol. cxci.**, p. 389. 1930.

8. JENNY, H.—Soil Research, **vol. i.**, p. 139. 1929.
9. LANG, R.—Int. Mitt. Bodenkunde, **vol. v.**, p. 312. 1915.
10. LIVINGSTONE, E. B., and SHREVE, F.—Carnegie Inst. Publ., No. 284. 1921.
11. McKIBBIN, R. R.—Sci. Agric., **vol. xiii.**, p. 413. 1933.
12. MEYER, A. Chem. der Erde, p. 209. 1926.
13. PERRIN, H.—Comptes Rendus, **vol. cxcii.**, p. 1,271. 1931.
14. PRESCOTT, J. A.—C.S.I.R., Bull. 52., 1931. Trans. Roy. Soc. S. Aust., **vol. lv.**, p. 65, 1931.
15. RUSSELL, T.—U.S. Monthly Weather Rev., **vol. xvi.**, p. 235. 1888.
16. STEFAN, I.—Sitz. ber. Akad., Wien, **vol. lxiii.** (2), p. 63., 1871; **vol. lxviii.** (2), p. 385, 1874.
17. SZYMKIEWICZ, D.—Acta Societatis Botanicorum Poloniae, 1923-1930: **Vol. i.**, p. 8, 1923; **vol. i.**, p. 244, 1923; **vol. ii.**, p. 130, 1924; **vol. ii.**, p. 239, 1925; **vol. iii.**, p. 115, 1925; **vol. iv.**, p. 55, 1926; **vol. vi.**, p. 93, 1929.
18. TRANSEAU, E. N.—Amer. Nat., **vol. xxxix.**, p. 875. 1905.

AUSTRALITES, PART I.
CLASSIFICATION OF THE W. H. C. SHAW COLLECTION

BY CHARLES FENNER, D.SC.

Summary

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During the course of the investigation Professor de Courcy Clarke, of the University of Western Australia, suggested communication with Mr. W. H C. Shaw, of Perth, who had been a collector of australites for many years. Mr. Shaw, when approached, generously offered to forward his collection to Adelaide for counting and classification. This was done, and the present paper is the outcome.

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By CHARLES FENNER, D.Sc., University of Adelaide.

[Read July 12, 1934.]

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I. INTRODUCTION.

Arising from conversations and correspondence with Dr. L. J. Spencer, of the British Museum, in 1931-2, the writer in 1933-4 undertook the compilation of a census of all the australites in accessible collections, with an analysis of the chief form types, together with a distribution map of recorded occurrences. This work is being continued.

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This paper represents the first systematic attempt to classify and describe the forms and surface features of the whole of a considerable collection of these mysterious and interesting objects. The Shaw collection contains 3,920 separate pieces. Although but a small proportion are perfect in form, with flanges, etc., 1,993 of them are sufficiently complete to be regarded as "whole" specimens.

Of the 1,927 broken specimens, 1,483 are readily identifiable and able to be classified; the forms and surface features of many of the fragments are as informative as some of the whole specimens. In the collection there are also included 344 nondescript fragments, many of which may yet prove to have special interest. From the point of view of numbers, this collection is comparable with the total number of specimens at present preserved in the museum collections of Australia.

For nearly 100 years the scientific world has shown a notable interest in tektites generally, and, since 1851, in australites in particular. There has been a steady output of papers, with special bursts of interest around the years 1898, 1908-9, and 1914; there has been a further notable evidence of increased interest in papers published during the past two or three years, partly due to the discovery of a new tektite series in Indo-China, and more particularly to the discovery of silica-glass in association with meteorite impact at Henbury (Central Australia) and Wabar (Arabia).

Prof. Franz E. Suess, author of the term australite, as well as of the more comprehensive term tektite, has recently summed up the whole of the published evidence (Die Naturwissenschaften, vol. xxi., p. 857, December 8, 1933), and strongly supports the theory that these bodies are "glass meteorites."

The present paper is purely descriptive, touching upon questions of genesis only in so far as it is necessary to do so in order to establish a basis of classification. The chemical and physical properties of the australite[1] material (and of tektites generally) are now reasonably well known. The present paper may add something to our knowledge of the average forms and weights, as well as of the surface features and the general distribution of australites. The points that call for further physical investigation are the forms, and the internal and external structural features (flanges, rims, internal flow lines, anterior flow ridges, etc.).

II. LOCALITY, DISTRIBUTION, ETC.

The Shaw collection of australites was made almost wholly from an area of about 30,000 square miles of the arid and sub-arid region of southern Australia, on and adjoining the Nullarbor Plain, as shown in the attached map, fig. 1. It is a matter of common knowledge that a very large number, possibly many thousands, of unrecorded australites has also been found distributed over this area, lying upon the surface. So far as is known, however, there are no comprehensive collections of these objects comparable with that of Mr. Shaw, apart from the collection made by Mr. S. F. C. Cook, of Kalgoorlie.

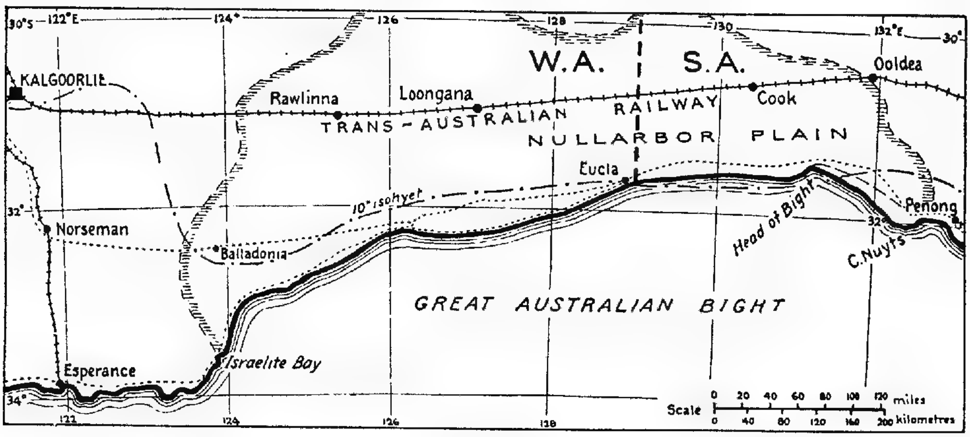

Fig. 1.

Sketch map of the locality where the Shaw collection was made, mainly along the coast between Eucla and Penong on the east, and Israelite Bay on the west; also along the Trans line between Rawlinna and Cook, and in the neighbourhood of Balladonia. The shaded broken line indicates the boundary of the tertiary limestones of the Nullarbor Plain; practically every specimen was found on this limestone area.

With one exception, to be noted later, this collection may be taken as representative of the average numbers, sizes, and types of australites as they lay widespread over the surface of the Nullarbor Plain. The area is a level plain, with a low and unreliable rainfall, and with no water-courses. It is a remarkably uniform geographical feature, a vast limestone plain with thin soils, without any

(1) Chemical composition: SiO_2 70+, Al_2O_3 13+, FeO and FeO_2 6+, MgO 2+, CaO 3+, K_2O and Na_2O 4+, with traces of Mn, Ti, Ni, and Co. Specific gravity: 2·3 to 2·5. Micro-structure: glass throughout. Colour: Pitch-black by reflected light; amber-brown to bronze-green by transmitted light.

siliceous rocks whatever. Until the coming of the coastal telegraph line in the south and the transcontinental railway line in the north, the area was practically uninhabited and almost unvisited, either by white or black man, except in the extreme west. The rainfall, vegetation, etc., improve towards Israelite Bay, where considerable numbers of australites were found. The distribution seems to have been widespread, and this is supported by the information gained from accounts of the building of the telegraph lines and the transcontinental railway line, when large collections were made by the men engaged on these works. The aborigines along the east-west (Kalgoorlie to Port Augusta) railway line trade australite specimens with passing travellers.

Since the area concerned is almost wholly a monotonous limestone plain, covered with low and sparse vegetation, without water-courses, and uninhabited, the suggestion that the distribution of the australites has been carried out by (a) running water, or (b) aborigines, receives no support. On the other hand, the facts of the distribution in this area strongly uphold the general belief held by Australian investigators that for the most part the australites have been found in the positions where they originally fell. Exceptions occur elsewhere, where concentration has taken place in the tin drifts and alluvial gravels of wetter districts in parts of Australia and Tasmania.

In a recent note in "Nature" (April 21, 1934, page 605) it was stated that tektites are "usually found in alluvial deposits, and are often waterworn and corroded." It is a remarkable fact that the australites in the Shaw collection, whether whole or broken, show well-preserved surface features, even where sharp edges are concerned, such as flow-ridges, rims, and flanges.[2] Not more than 2% of the whole of the material in this collection shows the pitting or wearing of the surface and edges that may be ascribed to transport or erosion by wind or water; apart from fractures of the flange or rim, over 90% of these specimens have well-preserved surface features and a fresh and unworn appearance.

Mr. G. F. Dodwell, B.A., Government Astronomer of South Australia, has had unique opportunity for the personal collection of australites within the area where the Shaw collection was made. When engaged in fixing the boundary between Western Australia and South Australia, Mr. Dodwell was twice camped on the Nullarbor Plain at Deakin, 30° 46′ S., 128° 58′ E., for eight days in November, 1920, and for three weeks in April-May, 1921. He frequently walked out over the plain after lunch, and succeeded in collecting 86 specimens over an area of about one square mile. The specimens included 23 round forms, mostly lenses, one teardrop, four elongates and 58 fragments. He states that he was always sure of finding a few specimens lying exposed upon the surface on the thin soil or bare limestone which characterises this area. Mr. Dodwell is of opinion that about 250 pieces were collected by his party over an area of a square mile, and the locality had possibly been collected upon by men working on the East-West railway line. The pieces were, on the whole, fairly evenly distributed.

Mr. Shaw, whose duties as an officer of the Commonwealth Post and Telegraph Department led to his being stationed in this area for a considerable period, has kindly supplied the following notes regarding distribution:—"I started collecting australites about 30 years ago, and during that time I have given hundreds away to museums and to private people who were collectors. As they take a very high polish, I gave away a lot of them to be made up into mourning brooches during the war. They are very hard and at the same time brittle, and must be treated by a lapidary. The australites in my collection were found in a district

(2) Other tektites (billitonites, moldavites, and indochinites) seem, in comparison with australites, to be not only much less regular in form, but also much more eroded; they appear to have been subjected to erosion for a longer period; they are also without the flanges or rims characteristic of australites.

extending from Eucla in the south to a point on the Trans line about opposite Eucla to the north, then west to Israelite Bay and Esperance. The majority were found in the vicinity of Israelite Bay. The natives used to find them close to and on the salt lakes (claypans), most of them being too small for my eyes to distinguish. Unfortunately, I have given practically all the large ones away; in fact, I borrowed the two largest ones to send with the collection; they were a couple I gave away some years ago."

Mr. Shaw has mentioned the one point in which his collection cannot be regarded as normal and average. It is that he had a tendency to give away to his friends the larger and the more perfect specimens, and in that respect his collection has suffered. For instance, the average weight of the dumbbells (70 specimens) in the Shaw collection is 1·217 grams, while that of the dumbbells (6 specimens) in a collection of over 100 sent to me by Mr. George Aiston, of Marree, is 3·1 grams. The tendency of most museum collections is possibly the reverse of that of the Shaw collection; they tend to consist rather of the larger and the better shaped forms, with a definite lack of the characteristic smaller forms, which were probably far more abundant in nature.

Possibly the higher proportion of water-worn specimens in museum collections is due to the fact that many were collected from alluvial (gold, tin, etc.) gravels. It is worthy of mention that, until in later years the natives were exploited as collectors of australites, the chief collectors were miners working in alluvial deposits. Even as far back as 1855, and possibly earlier, australites were well known to the gold diggers, who called them "button stones," *vide* W. B. Clarke, Q.J.G.S., 1855, p. 403.

III. BASES OF CLASSIFICATION.

The method of classification adopted is based primarily on the forms of the australites, and secondarily upon measurements of the longer diameters or axes of the objects. The classification is, as far as possible, genetic. That is, it is based on the development of the various forms, one from another. From the work of

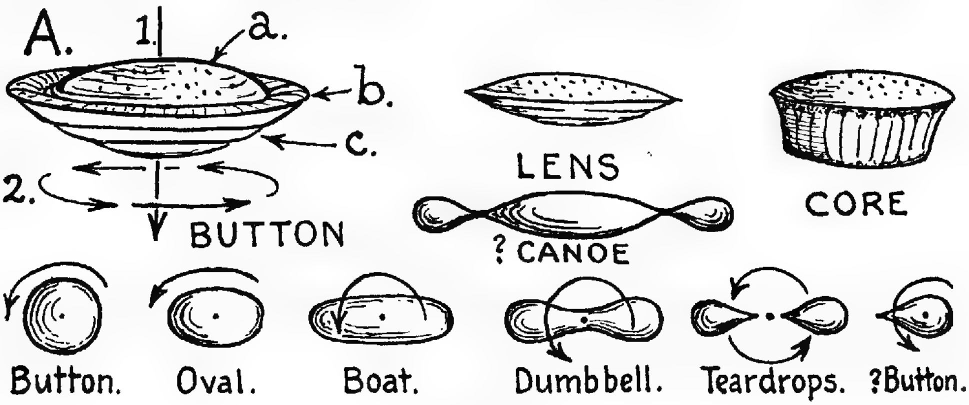

Fig. 2.

Sketches to illustrate the theory that is the basis of the terms used and of the genetic classification here attempted.

previous investigators a fairly clear idea has been gained of the successive steps in development of the australites, assuming them to have been blebs of molten glass moving forward through a gas and rotating rapidly in a plane normal to the direction of the movement. Thus we get the well-known series of forms as set out in fig. 2.

The commonest of all the australite forms is the typical "button," with or without a flange. Fig. 2A shows the method of development of this form, together with the descriptive terms used throughout this paper. A spherical bleb of glass (the "primary form") moving in the direction of arrow No. 1 and spinning in the direction of arrow No. 2 will fuse on the forward, or anterior, surface, and the melting glass will flow backward to form the flange or rim, producing the "secondary form." We thus get three well-marked parts which are characteristic of nearly all forms of australites, though the flange may not be well developed in all specimens (see fig. 2) :—

(a) The posterior surface, here called the back or the top of the object, which characteristically shows surface pittings due to gas bubbles, or an intricate pattern of flow lines in the glassy material, or both (see pl. ix.).

(b) The anterior surface, here called the front or bottom of the object, which is characterised by "flow-ridges," which may be concentric, spiral, or irregular; these are well shown in some of the plates.

(c) The surrounding flange or rim may be large as in Class A1a (the "buttons"), or very small as in Class A2a (the "lenses"), or subsequently lost by fracture, as in the greater number of australites recorded (see "core," fig. 2).

Round forms are by far the most abundant, and appear to be the most stable. In fig. 2 is shown a series of sketches to suggest the development of various forms from the button through the dumbbell to the teardrop; as several excellent samples testify, the tendency of the teardrop, when proceeding on its spinning flight, is to develop a flange and to approximate more closely to the button form (see pl. ix., No. E5).[3] Indeed, it does not require a very great effort of imagination to picture the whole of the known australites as derived from one original huge molten glassy sphere, successively dividing and re-dividing in the above-named sequence. Such a mental picture, which is suggested purely as an intellectual exercise, demands a relatively long period of travel through the gas in which the forms were developed.

A type, here called "canoes," pointed at both ends (pl. vi., A5a, 1-14), is somewhat puzzling, and Prof. Kerr Grant has suggested to the writer that it may be formed by the shedding of two "tear-drops," as suggested in the sketch in fig. 2.

These, then, are the bases of classification. It will be realized that there are no two australites in this collection which are alike, and although seven separate classes and 50 sub-classes have been necessary in order to make a reasonable classification, the possibility for a greater number of sub-classes was apparent, as was also the fact that almost every sub-class grades in both directions into other sub-classes, and the transitional forms are often somewhat difficult to place.

IV. NOMENCLATURE—GROUPS AND CLASSES.

No systematic attempt has previously been made to give names to the whole of the australite forms. A number of names, however, are fairly well recognised in the literature. Taking three that are well known, we have *(a)* bombs, *(b)* ovoids or ellipsoids, *(c)* buttons. Names such as "bomb" are undesirable in that they imply the method of origin, a point upon which we are still without positive knowledge. Terms such as ovoid, ellipsoid, apioid, etc., are also undesirable, as they connote exact mathematical forms, none of which occur as australites; that is to say, no two australites are alike in form, and no australite complies with the regularity of any one of the mathematical forms named. As we shall see later, when discussing the possibility of primary and secondary

[3] Prof. Walter Howchin has, in his private collection, a fine example of a flanged button which preserves traces of a tear-drop ancestry.

australite forms, the primary forms possibly approximated to the various mathematical conceptions here referred to.

The term "button," which is the one most commonly adopted for popular use ("blackfellows' buttons"), is also widely used throughout scientific literature. It is an excellent term, being descriptive, easily remembered, and non-committal both as to exact form and origin. The writer has, therefore, throughout this paper used similar commonplace and non-committal terms for the names of the various groups. Wherever possible these have been taken from previous literature; in a few cases fresh terms have been devised.

It was necessary to classify the broken fragments as well as the whole ones, and the following two main groups were therefore formed:—

Group A.—Whole specimens, or with flanges broken or missing; total: 1,993 specimens.

Group B.—Broken pieces; total: 1,927 specimens.

The following are the names of the various classes of Group A:—

Class.	Name.	Number of Sub-classes	Number of Specimens.	Average Weight in Grams.
A1	Buttons - -	12	275	1·305
A2	Lenses - -	11	1,094	·798
A3	Ovals - -	5	168	·939
A4	Boats - -	6	171	1·121
A5	Canoes - -	5	81	1·104
A6	Dumbbells - -	6	70	1·217
A7	Teardrops - -	5	134	·898
	Totals -	50	1,993	·931

It will be seen that the round specimens (buttons and lenses) predominate, there being 1,369 of them, with an average weight of ·884 grams. There are 490 elongates (ovals, boats, canoes, and dumbbells) with an average weight of 1·069 grams, and 134 teardrops with an average weight of ·898 grams. The question of the distribution of size and weight will be more fully dealt with in a later section.

Group B includes the broken pieces, **B1** comprising round forms, **B2** elongated forms, and **B3** nondescript pieces.

V. DESCRIPTION OF CLASSES AND SUB-CLASSES, GROUP A.

This portion of the paper should be read in conjunction with the accompanying plates, the reference numbers attached to the photographs of the various australites being the same as those used throughout this classification.

Class A1—Buttons, with the following sub-classes, examples of each of which are shown in the plates.

A1a.—Buttons with perfect flanges, 7 specimens, average weight 2·63 grams. These are the most striking and beautiful of all the forms known, and possibly represent the dominant type formed. See pl. iv., 1-12.

A1b.—Buttons with imperfect flanges, subdivided as follows; these are shown in pl. iv., Nos. 1-2 showing the upper and 3-6 the lower ridged surfaces:—

		No.	Av. Weight.
(i.)	imperfect flanges, half remaining - -	22	2·35 gms.
(ii.)	,, ,, quarter to half remaining -	17	1·85 ,,
(iii.)	,, ,, less than quarter remaining:		
	(a) 14–16 mm. dia. -	27	1·85 ,,
	(b) 10–14 ,, ,, -	43	1·15 ,,
	(c) < 10 ,, ,, -	17	·51 ,,

A1c.—This class consists of buttons in which cavities caused by gas bubbles appear on the surface. Some very striking forms are known in which a very large bubble or bubbles occupy the whole of the interior of the australite. A sub-class *(i.)* has been set apart for these forms, but there are no complete representatives in the Shaw collection; there is one large fragment that appears to be part of such a form.

A1c. (ii.*)* consists of those buttons which have the bubble cavity in the centre of the top of the button; 15 specimens, average weight ·98 grams (see pl. iv., A1c, 1-3).

A1c, (iii.*)* includes 36 specimens with one, two, or more open bubble cavities, which are not concentrically placed. The average weight is 1·08 grams.

A1d.—Buttons which have a peculiar and unexplained defacement, consisting of a parallel-sided groove, often curved, penetrating deep into the material of the australite. Including the fragments, 150 specimens in this collection show such features. They do not appear to be cracks due to contraction, and the writer has preferred to name them "saw-cuts," which they closely resemble, and which word can convey no possible implication as to their origin. They may be shrinkage cracks, but they do not look like it (see pl. iv., A1, 1-3).

A1e.—While the great majority of buttons have rounded (spheroidal) tops, there is a very definite class of somewhat smaller buttons with a tendency towards what Professor Skeats (Roy. Soc. Vic., 1914) has termed the "pine-seed form," almost or quite flat on the top. This class includes 67 specimens, with a fairly wide variety of size, etc., average weight ·47 grams (see pl. iv., A1e, 1-9). Rare samples have very wide, flat flanges.

A1f, which would include a very large number of the specimens of most museum collections, consists of "cores" (see fig. 2). That is to say, they are regular buttons from which the flanges have been broken off. It will be pointed out later that the flange is not closely connected to the main body of the australite, and that it is to be expected that the flanges may be easily removed by abrasion, insolation, temperature variation, bush fires, etc. After the flange is gone there appears to be a tendency for further flaking around the equatorial zone, so that the cores become smaller and smaller. A characteristic button core, showing the fractured zone and spherical top, is shown in pl. ix., E1, and a sketch in fig. 2.

The largest specimen in the Shaw collection is a core. It constitutes sub-class A1f *(i.)*, weighs 37·16 grams, is 37 mm. in diameter and 22·6 mm. thick. So far as can be ascertained, all the largest australites recorded, and most of the very large ones which the writer has personally examined, belong to this sub-class.

A1f, *(ii.)* consists of 16 smaller cores, average weight 2·83 grams. These forms are important; Thorp (W.A., 1913-1914) refers to them as "conical." They have in most cases lost the anterior fluxion ridges but retain the pitted or flow-lined spheroidal tops. Pl. iv., A1f, 1-6 show the upper surface, while Nos. 7-12 show them side on. The smallest cores (over 150 specimens) have been placed with the "fragments."

Class A2. Lenses.—Bi-convex forms, mostly with a sharp rim, the forward surface showing the usual flow ridges and the upper surface being nearly smooth or slightly pitted. The flange is usually not well developed, and is more conveniently distinguished by calling it a "rim" (see pl. v., A2a, 8-13). It may be that the lens is a development from the normal flanged button, having lost its flange in the course of development, and just started to develop a fresh one. In any case, it appears to be a very stable form and completely surpasses in numbers all other forms in the Shaw collection, being four times as abundant as

the various forms of buttons. There are 1,094 lenses in the collection, and 623 are shown on a reduced scale in pl. vii. See also three top rows in pl. v.

The lenses have been divided into sub-classes as follows, according to size. In the two rows of larger specimens, A2a, pl. vii., the upper row shows the bottom (ridged) surface, and the lower row shows the top (pitted) surface:—

A2a.—14 to 16 mm. diameter, 69 specimens. av. weight 1·68 grams.
A2b.—12 to 14 mm. diameter, 177 specimens, av. weight 1·22 grams.
A2c.—10 to 12 mm. diameter, 350 specimens, av. weight ·78 grams.
A2d.—8 to 10 mm. diameter, 341 specimens, av. weight ·48 grams.
A2e *(i.)*.—6 to 8 mm. diameter, larger, 77 specimens, av. weight ·286 grams.
A2e *(ii.)*.—6 to 8 mm. diameter, medium size, 12 specimens, av. weight ·221 grams.
A2e *(iii.)*—6 to 8 mm. diameter, smallest, 6 specimens, av. weight ·166 grams.

In this last-named sub-class occur the smallest recorded specimens. The extreme example is a very perfect lens of ·15 grams in weight.

A2f.—This sub-class is termed the "pitted discs." They tend to be flat on both sides and are heavily pitted on the top and bottom, with no sign of the usual external form and sculpture of the lens. They appear to have been derived from lens-shaped australites by erosion and abrasion. This group stands out from the others because, while most of the specimens in this collection have retained their external features with remarkable definiteness, these specimens appear to have undergone weathering or chemical erosion; even so, the erosion is in no case of an extreme type.

(i.)—Larger, 6 specimens, average weight 2·02 grams.
(ii.)—Intermediate, 44 specimens, average weight ·873 grams.
(iii.)—Smaller, 6 specimens, average weight ·46 grams.

A2g.—This is a peculiar and puzzling sub-class, not hitherto referred to, in which the top portion of the specimen has developed a series of ridges that may be likened to the edges of a pudding cloth which does not cover the whole pudding. They are better explained by the photograph shown on pl. ix., F1-12. They are here called "crinkly tops," and a similar series is found among the elongate specimens (sub-class A4f). Six round specimens, average weight ·78 grams. Plate ix. F, shows both elongate and round forms.

Class A3, Ovals.—The ovals require no special description. The sub-classes are as follows:—

A3a.—Ovals, with perfect flange. These are very beautiful objects, really "oval buttons." A specimen of this type was given by Sir Thomas Mitchell to Charles Darwin, and is regarded as the first recorded australite. Two specimens, average weight 2·575 grams (see pl. v., A3a, 1-2). Nos. 3, 4, 5, 6 show different aspects of the same pair of australites.

A3b.—Ovals, with flange missing or imperfect, long axis 18 to 21 mm., 18 specimens, av. weight 2·01 grams.
A3c.—As above, long axis 14 to 18 mm., 50 specimens, av. weight 1·22 grams.
A3d.—As above, long axis 10 to 14 mm., 81 specimens, av. weight ·64 grams.
A3e.—As above, long axis 8 to 10 mm., 17 specimens, av. weight ·214 grams.

Ovals are figured on pl. v.—top, bottom, and side views. The smallest oval specimen is a beautifully preserved sample with clear-cut edge and anterior flow ridges, weighing ·20 grams (pl. ix., E11).

Class A4, Boats.—The following are the sub-classes:—

A4a.—This group consists of specimens which are more elongate than the ovals and have somewhat parallel sides, but which had not yet developed "waists."

Most of these specimens have the flanges wholly missing or imperfect, but there is usually some definite trace of the existence of a larger or smaller flange or rim. The anterior flow ridges are often irregular. See pl. v., A4a, for top, bottom, and side views:—

A4a.—Long axis 20 to 30 mm., 15 specimens, average weight 2·24 grams.
A4b.—Long axis 18 to 22 mm., 75 specimens, average weight 1·35 grams.
A4c.—Long axis 14 to 18 mm., 52 specimens, average weight ·53 grams.
A4d.—Long axis 12 to 14 mm., 14 specimens, average weight ·356 grams.
A4e.—Here we have a peculiar and varied group of elongated australites, remarkably thin and flat in cross section, as shown by pl. viii., A4e, Nos. 1-4; Nos. 3 and 4 are two views of the same specimen. Most of the samples very clearly show sharp rims and flow ridges and many of them are translucent, and are amber-coloured by transmitted light. Eight specimens, average weight ·321 grams.(4)

A4f.—"Crinkly tops." The same comments apply as in sub-class A2g above; 7 specimens, average weight 1·65 grams.

Class A5, Canoes.—These are on the whole somewhat similar to boats, but are usually narrower and are pointed at both ends. See fig. 2 re possible origin. Many of them have a small but fairly perfect sharp equatorial rim; in a small number there is a flange, but it is imperfect or broken off (see pl. vi., A5a, 1-14; also A5, 1-4.) The following are the sub-classes:—

A5a.—Long axis 22 to 30 mm., 22 specimens, average weight 1·56 grams.
A5b.—Long axis 18 to 22 mm., 18 specimens, average weight 1·18 grams.
A5c.—Long axis 14 to 18 mm., 28 specimens, average weight ·631 grams.
A5d.—Long axis 12 to 14 mm., 7 specimens, average weight ·452 grams.
A5e.—These forms are termed "aberrant elongates" and include a series that cannot be placed in any other sub-class. Their peculiarities lie both in their forms and in their flow lines, and will be dealt with in some detail in a later section. In pl. viii., A5e, Nos. 1-4, show two views of each of two specimens: 1-2 has flow lines on both surfaces, 3-4 is abnormally crescentic in longitudinal section.

Class A6, Dumbbells.—These are a development from the boat type, in which the two ends tend to pull apart and thus to form a "waist," giving the characteristic dumbbell outline. A few dumbbells (the so-called "peanut" forms) are round and not lenticular in cross section, as shown in the specimen figured as A6a, Nos. 9 and 13, pl. vi. Few dumbbells show wide flanges, but many of them have evidence that a flange or rim was developed. The flange is often no more than a sharp rim, like those of the lenses and canoes. See pl. vi., A6a, 1-6, A6b, 1-4, A6a, 7-14; 7-10 are the same specimens as 11-14, but differently illuminated. The sub-classes are:—

A6a.—Long axis 30 to 35 mm., 5 specimens, average weight 2·648 grams.
A6b.—Long axis 25 to 30 mm., 23 specimens, average weight 1·457 grams.
A6c.—Long axis 20 to 25 mm., 25 specimens, average weight ·860 grams.
A6d.—Long axis 15 to 20 mm., 7 specimens, average weight ·51 grams
A6e.—"Ladles." This is a peculiar group of aberrant dumbbells in which one end is characteristically larger than the other, and their rotation appears to have taken place with the larger end in an advanced position with respect to the smaller end. The flow lines characteristically extend up the "handle" of the ladle as shown in the photographs. They are particularly interesting forms. See

(4) If australites tended to become smaller and smaller during flight, by fusion and evaporation, these forms may represent specimens that were approaching the stage of complete disappearance.

pl. viii., A6e, 1-7. A6e, Nos. 1 to 3, represent different aspects of the one specimen. 5 specimens, average weight 2·00 grams.

A6f.—Beans or Kidneys. These are flat, uninteresting specimens, which may be more closely related to the ovals than to the dumbbell forms. 5 specimens, average weight ·676 grams. Pl. viii., A6f, 1-2.

Class A7, Teardrops.—These are the forms which arise when a dumbbell in its revolutions has torn completely apart. Though all the teardrops in the Shaw collection are small, some very large ones are in existence, and samples of these larger ones are shown in the photographs (pl. ix., E5 and E6). Some of the most puzzling forms, which are also rare, are those in which we find a teardrop continuing its revolution and developing the form of the flanged button, but still retaining evidence of its teardrop ancestry (see pl. ix., No. E5). The sub-classes are:—

A7a.—Short axis 12 to 15 mm., 6 specimens, average weight 1·92 grams.
A7b.—Short axis 10 to 12 mm., 21 specimens, average weight 1·23 grams.
A7c.—Short axis 8 to 10 mm., 45 specimens, average weight ·731 grams.
A7d.—Short axis 6 to 8 mm., 39 specimens, average weight ·417 grams.
A7e.—"Air bombs," and other exceptional flow-lined forms. This is one of the most interesting sub-classes, and one in which no two specimens very closely resemble one another. Certain puzzling features of this sub-class are dealt with later, and they are shown on pl. viii., A7e, 1-14. Nos. 5 and 12 are two views of the same form, the "air bomb." 23 specimens, average weight 1·472 grams.

VI. DESCRIPTION OF CLASSES AND SUB-CLASSES, GROUP B.

This group, as already explained, consists of broken specimens and fragments. Apart from the fracturing that has taken place, the external appearance of these fragments is in most cases quite fresh and unworn. Possibly the greater part of this fracturing is due to grass and scrub fires passing over the country where they lay. A very high proportion have fragments of well-developed flanges attached to them; a careful and detailed examination, involving the handling of each specimen many times, failed to reveal that any two parts belonged to the one australite. There was one exception, mentioned later. It is reasonable to assume that almost every piece in Group B represents a separate australite.

With one exception these fragments are all of the normal sizes recorded for Group A. It was, therefore, not necessary to weigh them, as the weights would be of no particular value. The exception, so far as size is concerned, was a fragment of a large dumbbell, without flange or rim, the weight of which was 24·85 grams, probably representing an original specimen which weighed at least 80 grams.

There are three classes in this group:—

Class B1.—Round forms, mostly buttons and lenses.

Class B2.—Elongate forms, including ovals, boats, and dumbbells; the teardrop fragments have also been included.

Class B3.—Nondescript fragments.

Class B1: Round Forms.—A brief description of each sub-class and the numbers in each are as follows:—

B1a.—Buttons with saw-cuts, fragment greater than half, 18 specimens.
B1b.—Buttons with saw-cuts, fragments less than half, 66 specimens.
B1c.—Buttons with concentric fractures, large, flanged, 32 specimens (pl. viii., B1c, 1-5).
B1d.—Buttons with concentric fractures, small, with imperfect flanges, 187 specimens.

B1e.—Fragments consisting of central conical pieces such as would result from the two foregoing sub-classes, 87 specimens (p. viii., B1e, 1-6).
B1f.—Button cores, larger, 20 specimens.
B1g.—Button cores, smaller, 106 specimens.
B1h.—Button cores, weathered and abraded, 26 specimens.
B1i.—Button fragments with bubble cavities, 28 specimens.
B1j.—Button fragments with flanges, larger, 23 specimens.
B1k.—Button fragments with flanges, smaller, 181 specimens.
B1l.—Fragments without flanges, possibly of lenses, 206 specimens.

Class B2: Elongate Forms.—The following are the sub-classes:—

B2a *(i.)*.—Elongate forms with saw-cuts, ordinary, 39 specimens.
B2a *(ii.)*.—Elongate forms with saw-cuts ("trilobites"), 20 specimens (see pl. viii., B2a, 1-7).
B2b.—Varied elongates with concentric fractures, 51 specimens.
B2c.—Elongate fragments, with unusual "flow-ridges," etc., 10 specimens.
B2d.—Elongate forms with bubble cavities, 42 specimens.
B2e.—Elongate forms, mostly cores of varied types, some very irregular, 36 specimens.
B2f *(i.)*—Boats, larger fragments, 130 specimens.
B2f *(ii.)*.—Boats, smaller fragments, 172 specimens.
B2g *(i.)*.—Dumbbell fragments, larger, 27 specimens; this sub-class includes the large fragment already mentioned, 24·85 grams.
B2g *(ii.)*.—Dumbbells, small fragments, 52 specimens.
B2h.—Teardrop fragments, 24 specimens.

Class B3: Unclassified Fragments.—The following are the sub-classes:—

B3a.—Nondescript fragments, 340 specimens, of which the total weight is about 150 grams.
B3b.—Flakes, accidental or aboriginal, 4 specimens.
B3c.—Foreign bodies, 10 specimens. In each of four collections which the writer has examined, it has been found necessary to recognise the fact that a small proportion of the bodies collected are not really australites at all. Among the various pseudo-australites one finds fragments of dark-coloured rock, bits of hard charcoal, or small pieces of well-polished limonite; in the Shaw collection there were four plant-seeds of a peculiar kind which looked remarkably like special types of australites, and were so regarded until their specific gravity was determined.

VII. SMOKE BOMBS.

Mr. D. J. Mahony, Director of the National Museum, Melbourne, has kindly drawn under my notice certain objects called "smoke bombs" (also called "slag bombs"), which may be collected from the surface of any part of a railway train upon which material from the smoke of the engine falls. Mr. Mahony further supplied a photograph which he exhibited at a meeting of the Royal Society of Victoria somewhat over 20 years ago (Summers, A.A.A.S., Melb., 1913, pp. 194-5), and which is reproduced in fig. 3.

Although these forms are microscopic, one realizes at once that they contain forms similar in outline to those of all the commoner australites—buttons, ovals, boats, dumbbells, teardrops, etc. Those shown in fig. 3 are magnified about six diameters. By the courtesy of Mr. E. H. Shapter a supply of dust was obtained, taken from the hollows at the rear end of the tender of a mountain type engine, as well as some dust from the inside of the smoke-box of a suburban engine. No

blebs were found in the latter sample, and an examination of the material from the tender showed, in the first place, a predominance of coke particles.

When these had been floated or blown away the remaining material was found to contain innumerable microscopic forms comparable to those shown in fig. 3, but even more microscopic in size. They were of various colours—transparent, china-white, silver-grey, and so on. Nearly every one contained a large number of minute gas bubbles in the interior. The forms, on the whole, had very clean surfaces, but some were tubercled, though none were pitted or grooved so far as could be detected. Tiny spheroids were by far the most abundant forms, but dumbbells, pears, teardrops and other similar types were readily to be found. Similar forms have been recorded from blebs of wind-blown lava (Hawaii) and from blebs of fused silica from meteoritic impact (Henbury).

In spite of this striking similarity, it is necessary to emphasise the point that in all the thousands of these smoke bombs which were examined microscopically there was not one form which really resembled a characteristic australite form. This leads to the necessity for recognising, in any discussion of the genesis of australites, two forms:—

(a) The primary form, probably similar to those of the smoke bombs, as originally developed in the case of each australite.

(b) The secondary form, which is a lessened and flatter form in each case, due to the fusing of material from the forward portion and its backward flow to form the flange, or perhaps a series of flanges, if these were shed during flight.

Each australite, therefore, as we know it, appears to represent a portion, mainly the posterior portion, of the original form, a considerable part of the anterior portion having disappeared or been displaced due to friction and fusing; the possibility of evaporation must also be considered.

Walcott (Royal Society of Victoria, 1908, p. 34) pointed out the remarkable difference between the top and the bottom (back and front) portions of each australite. "These two hemispheroidal portions," he wrote, "are sharply defined by the ridge, as if two diverse agencies were at work in their formation."

It would appear that the secret of the origin of the australites must be sought from these two aspects: *(a)* The sources of the material and the forces that formed the original regular "smoke bomb" types of forms; *(b)* the rapid forward movement, spinning, through a gas, with fusion of the forward surface and the formation of flanges, rims, and flow-ridges.

VIII. FLANGES AND RIMS.

These are among the most characteristic features of australites, and in well-developed forms they are very regular and beautiful, as shown in pl. iv., top row. The possession of these flanges, together with their more regular forms, places the australites in a class distinct from other tektites, such as the schonites, the moldavites, the billitonites, the indochinites, and the doubtful tektites called queenstownites.

In some cases, as in the lenses, canoes, etc., the flange may be a mere projecting, sharp edge (herein called a "rim"), while in its fullest development (as a "flange") it occurs as in fig. 2A and in the top portion of pl. iv. The evidence of the Shaw collection is to the effect that almost all australites underwent fusion on the front surface and developed a flange or a rim. The rare exceptions exist in single cases such as the air bomb, pl. viii., A7e, 5 and 13, the large teardrop, pl. ix., E6 (which may be water-worn), and in other forms which possibly changed their direction during flight.

It is necessary that attention should be drawn to the precarious connection that exists between the flange and the body of the australite. This is very clearly brought out in the beautiful microscopic sections published by E. J. Dunn (Bulletin No. 27, Geological Survey of Victoria, 1912), a copy of one of which is reproduced in fig. 3. It will be seen that the flange is connected with the main body only at the forward end, and then only by a thin strip of glassy material which was in the process of flowing backward when solidification took place.

With the loss of the flange the button becomes a core, characteristic examples of which are shown in pl. iv., A1f, 1-12. There appears to be a tendency for further flaking along the equatorial zone, and the core tends to become smaller and smaller. These cores are perhaps the commonest forms in most museum collections. This particular type of fracture may be the result of internal strains in the body of the australite. Several large australite specimens not belonging to the Shaw collection were courteously lent by the South Australian Museum, to illustrate the characteristic belt of flaking along the "flange zone." These are shown in pl. ix.: Button (E1), dumbbell (E3), boat (E7), and teardrop (E6).

Kerr Grant (Roy. Soc. Vic., 1908, p. 447) refers to possible markings on australites due to impact while in the plastic condition. In this collection there has been noted but one mark capable of such interpretation, and this is shown fairly clearly in two views on pl. iv., A1a, Nos. 7 and 10. This particular marking might be better explained as a variation in fusion and flow, owing to the presence of a bubble cavity (which can be seen in the illustration). Marks of impact may be considered as non-existent upon australites. The evidence is thus in favour of the belief that these bodies were considerably slowed down during the latter part of their flight, with consequent cooling and solidification. It cannot be doubted that all of them reached the earth's surface as solid bodies.

IX. FLOW RIDGES.

The flow ridges which form on the front surface of the australites are very well shown in many of the plates. The ridges are very characteristic, and in the majority of the specimens in the Shaw collection they are well preserved. There is, on the whole, a noteworthy evenness in the distance from crest to crest of the waves which were developed in the molten glass. The average width of the grooves between the flow ridges is about 3 mm. The variations noted are from 2 to 4 mm. (see pl. viii., A6e, 1-7).

On the round forms the grooves are sometimes spiral and sometimes concentric. Out of 75 buttons with well-developed grooves, selected at random, there were 42 in which the flow ridges were arranged in concentric circles, 15 with a clockwise spiral and 18 with an anti-clockwise spiral. The regularity of these waves is perhaps best indicated in the microscopic section shown in fig. 3, where the outline of six successive flow waves may be clearly distinguished.

In the oval and most elongate forms the flow ridges behave somewhat as they do in the buttons and lenses. However, as may be seen from figs. 1 to 14, pl. viii., A7e, they are in other forms sometimes quite irregular and sometimes with curious symmetrical closed patterns.[5] A few forms, particularly in Class A5 and A7, suggest that the objects changed their direction during flight, as they

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[5] It is suggested that the peculiarities of the more unusual forms, which include sub-classes **A5** (canoes), **A5**e (aberrant elongates) and **A7**e (air-bombs and other curious flow-lined forms), may be explained by their derivation from a "double-waisted dumbbell" as sketched in Fig. 2; the shedding of one tear-drop prior to the other would upset the equilibrium of the body and necessitate readjustment, possibly causing a fresh orientation towards the direction of flight, with the development of a new set of flow-ridges.

have flow ridges on both "front" and "back." Others appear to have moved lengthwise (end on) through the air and to have developed grooves along their whole length. Some of the most striking of these features are shown in the photographs, and need no further detailed description.

A peculiar phase of the flow of material appears to be shown in a small percentage of the objects which are here classified as the "crinkly tops," sub-classes A2g and A4f. These forms characteristically show little or no sign of a flange, but have definite flow ridges on their anterior face.

It is suggested that the material which fused and flowed backwards did not form a projecting flange, but crept round the back of the object and covered up portion of the original surface, all excepting the central part. This peculiar appearance is shown in the photographs in pl. ix., F1-12, all of which show the "top" (back) of the specimens.

X. INTERNAL STRUCTURES.

The work done on this collection of australites, coupled with a study of the previous literature on the matter, emphasises the need for a closer physical investigation of the internal structures. This is particularly the case when one comes to consider the distinction between the primary forms and the secondary

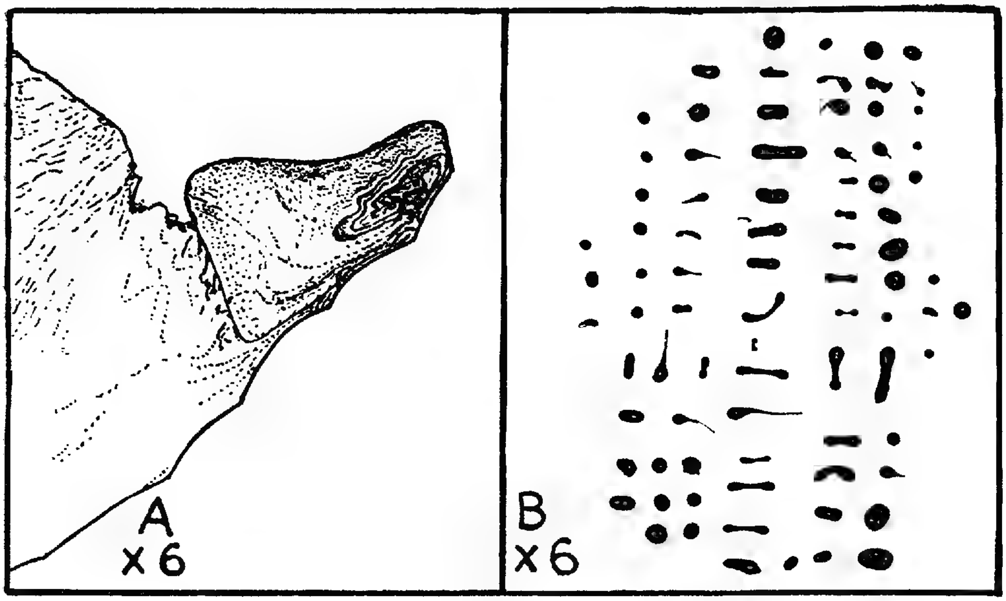

Fig. 3.

A represents a microscopic section through portion of a flanged button, magnified six diameters, after E. J. Dunn. Note: (a) the internal flow lines in both the body of the australite and in the flange, (b) the wave crests of the flow ridges on the front (lower) face, and (c) the imperfect union between the material of the flange and the body of the object. B represents "smoke bombs," from D. J. Mahony, magnified six diameters, as described in the context.

forms of australites, and to endeavour to separate and distinguish the two sets of forces which have possibly been in operation in producing the completed object.

The internal flow lines of the material of the flange are shown in fig. 3, and their arrangement is of a striking and puzzling character. The flow lines that may be detected within the interior of the glassy mass that forms the body of

the australite are equally puzzling, and are remarkably complex in many cases. These internal flow lines, together with the gas bubbles and their arrangement, must necessarily all take part in the story of the "primary" formation of the australites, while the fused "skin" of the front of the australite, the anterior flow ridges, and the almost bubble-free, flow-lined flange, has to do with the "secondary" forms impressed upon the australites. The flow lines (not flow ridges) sometimes show on the surface, as in three specimens selected to illustrate that point in pl. ix. Of these No. E2 is a button (110 grams), lent by Mr. S. F. C. Cook, of Kalgoorlie; No. E8, a boat, lent by Prof. Kerr Grant; and No. E4, a dumbbell, lent by the S.A. Museum authorities.

In studying the fragments classified under Group B some interesting features were noted, such as the gas cavities, concentric fractures, and "saw-cuts." Minute pits on the posterior surface, due to burst gas bubbles, are very common. Larger bubble cavities are shown in plate iv., A1c. These naturally tend to be at the back of the object, though occasionally one is found upon the flow-ridged (front) surface. Among the fragments there are many which obviously belonged to forms that contained bubbles up to 2 or 3 centimetres in diameter.

Among the fractures, one particular type (see Nos. 1-5, pl. viii., B1c) consisted of concentric fractures. These occur both in the button type and in the elongates, but tend to have a flatter angle in the latter than in the buttons. The photographs will provide sufficient description of the features, and it will be noted that over 270 separate pieces of the Shaw collection show concentric fractures. It may be the outward physical sign of an inward physical structure or strain. The pieces which come out of these concentric breaks are almost conical in form, but usually have some irregularity, as shown in Nos. 1-6, pl. viii., B1e. Possibly most of the fragmentation was due to bush and scrub fires, and to the rapid alternation of extremes of heat and cold.

A considerable amount of time was spent in the endeavour to find two pieces in the 2,000 fragments of the Shaw collection which fitted one another, and success was achieved in one case, where the fragment of a flanged button with a concentric fracture was mated with a conical-centre fragment. There is, of course, a possibility that this fracture took place within the box during transport.

Brief mention will be made of the features termed "saw-cuts." The reason for this name is given elsewhere, and examples are shown in pl. iv., A1d. Counting both the whole and broken specimens, not less than 150 showed definite saw-cuts. These markings are parallel-sided and usually penetrate deep into the australite. They have not the appearance of shrinkage cracks. The appearance is more as if streaks of some soluble material had been originally incorporated in the glass and had later been weathered out, but they may be due to some peculiar type of shrinkage which occurs at some stage in the cooling of a glassy mass. They do not tally with anything known to me from common experience. Somewhat similar markings, but of a more shallow type, have been noted on billitonites, moldavites, and ordinary obsidian pebbles, as figured by G. P. Merrill (Proc. U.S. Nat. Mus., vol. xl., pl. 61-62, 1911).

XI. FORMS AND WEIGHTS, DISTRIBUTION CURVE.

Just as the spherules are by far the most abundant forms among the smoke bombs, so are buttons the commonest forms among australites. Counting the whole of the 3,576 identifiable pieces in the Shaw collection, 2,349 are "rounds" and 1,227 are "elongates," a ratio of about twice as many rounds as elongates (including teardrops). This ratio does not tally with other estimates made, but it is more likely to be correct (thanks to Mr. Shaw's patient collecting) as it deals with a much larger collection and one of a more comprehensive type than any hitherto dealt with.

TABLE OF WEIGHTS.

Average Weight of Group in Grams.	Number in Group Round.	Elongate.	Total.
< ·2	6	—	6
·2– ·4	89	39	128
·4– ·6	431	66	497
·6– ·8	356	114	470
·8–1·0	59	25	84
1 –1·2	79	18	97
1·2–1·4	177	125	302
1·4–1·6	—	45	45
1·6–1·8	69	7	76
1·8–2·0	44	—	44
2·0–2·2	6	29	35
2·2–2·4	22	15	37
2·4–2·6	7	2	9
2·6–2·8	7	5	12
2·8–3	16	—	16
	1,368	490	1,858
	Av. ·885 grams	Av. 1·069 grams	Av. ·934 grams

The general and relative weights of the australites in this collection have been investigated. The average weight of the "whole" specimens is nearly one gram (·931). The accompanying table shows the average weight in grams of each group of 1,858 complete australites, the round forms separate from the elongated forms. These weights were taken in groups at intervals of ·2 grams. When the distribution curve was plotted, as shown in fig. 4, it was found to have two distinct peaks, one about ·6 to ·8 grams and one at 1·4 grams.

This led to a re-examination of the weights, and it was found that most of the individual groups gave an adequate representation of their average weight. The particular sub-classes that were included in the 1·4 section, however, were of very varied sizes. They included 177 specimens of sub-classes A2b, 50 specimens of sub-class A3c, and 75 specimens of sub-class A4b. A number of the largest and the smallest were taken out of these sub-classes and weighed separately, and more detailed averages obtained. The re-distribution thus effected enable the probable distribution curve to be plotted as shown by the broken line in fig. 4. This distribution curve also shows its peak at about the average weight of the australites in this collection.

XII. LARGEST AND SMALLEST SPECIMENS.

Though there appear to be few very small australites, just as there are few very large ones, yet there is a remarkably wide range of variation. The smallest specimen in the Shaw collection weighs scarcely ·15 grams, while the largest specimen that has come under notice weighs 218 grams; that is to say, the largest known is 1,450 times as large as the smallest known.

It has already been mentioned that the Shaw collection is somewhat lacking in the larger specimens. Mr. Shaw has explained the lack of such examples as follows:—"I gave away several of the perfect button-with-flange type, some of which did not have a blemish of any sort. I gave away or lost at least half a dozen as large, if not larger, than the biggest (37 grams) I sent you. The lack of the usual proportion of larger ones amongst the collection is due to a certain extent to the fact that when giving away these stones, I allowed people to pick them out themselves. They nearly always picked a size suitable for mourning brooches; these would not be very large and not too small."

In support of the distribution curve shown in fig. 4 it may be suggested, from the writer's knowledge of the museum collections of Australia and of various other private collections, that the distribution curve is approximately correct for australites generally.

Very large australites are rare. For purposes of record, note is made of the following:—The largest known specimen appears to be that mentioned by Dr. Glauert, Curator of the Western Australian Museum, in a personal letter (27/3/34). It is No. 4,455 in the Museum collection and weighs 218 grams. No. 3,491 in the same collection weighs 147 grams, and No. 11,177 weighs 116 grams.

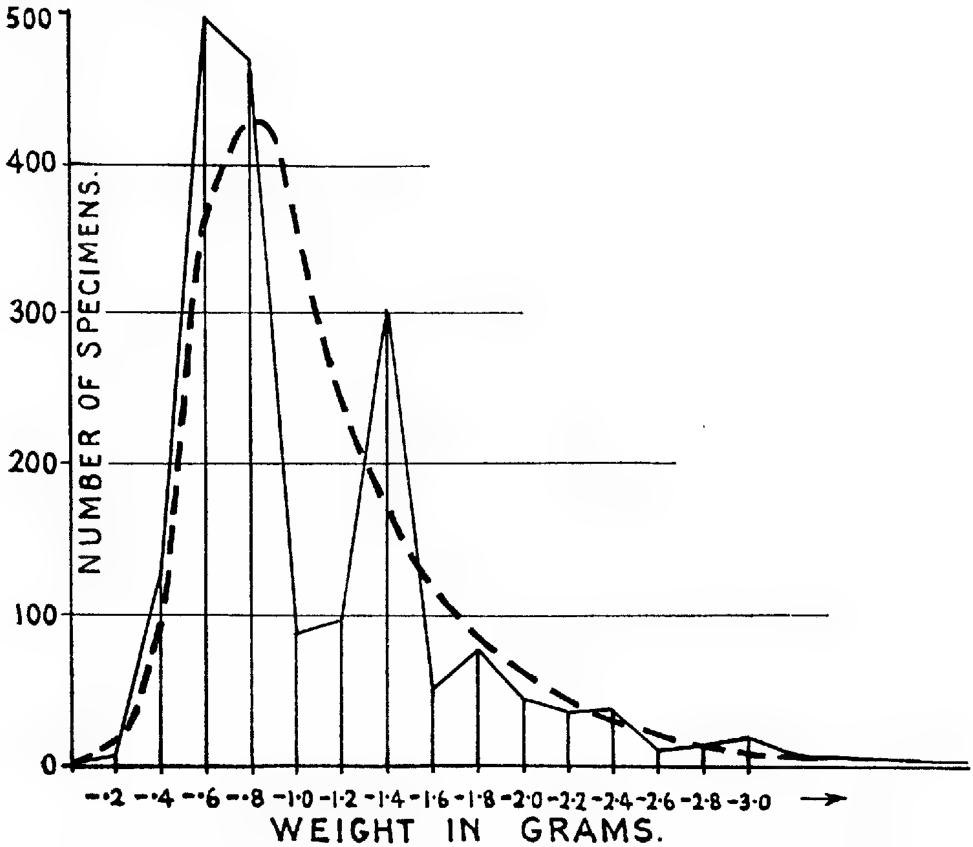

Fig. 4.

Distribution curve of the weights of australites, as described in the context.

The last-named specimen, of which there is a cast in the British Museum, was found by Sir John Forrest, and has long been regarded as the largest known australite. Mr. Shaw states that "the largest he remembers seeing was perfectly round and weighed about 142 grams (5 ozs.). This was sent to a jeweller in Melbourne, and it split into pieces when they were treating it; it was then thrown away—at least that was the explanation given. This specimen was found in the vicinity of Eucla by a native woman; the native name for this stone is Nooloo." The largest specimen known to the writer from this area is shown in plate ix., and is in the collection of Mr. S. F. C. Cook, of Kalgoorlie. It was found at Norseman (see fig. 1), and (as kindly determined by Sir Douglas Mawson) weighs 110·575 grams, and has a specific gravity of 2·44. It is approximately

circular in plan, 51 mm. in diameter, and 33·8 mm. thick. Of the large specimens shown in plate ix., in illustration of various features, the following are the names of the owners and the localities where found:—E1, W. M. McDonald, Loxton, S.A.; E2, S. F. C. Cook, Norseman, W.A.; E3, S.A. Museum, Wirramutta, S.A.; E4, S.A. Museum, Yunta, S.A.; E5, S.A. Museum, Renmark, S.A.; E6, S.A. Museum, Diamantina (S.A. or Q.); E7, S.A. Museum, Mount Gambier, S.A.; E8, Prof. Kerr Grant, Central Australia.

When we come to consider the smallest known specimens, we find that Dr. Thorp, of Western Australia, in 1913 recorded the smallest australite as one weighing 4·9 grains (·317 grams). In 1914 Professor Skeats, in the Victorian Royal Society, described a disc-like form weighing ·3184 grams.

The Shaw collection is rich in small specimens. From the smallest group of the lenses, A2e (iii.), the average weight of six is ·166 grams, and of these the smallest and most perfect, which is 7·25 mm. in diameter and 2·5 mm. thick in the centre, weighs ·15 grams—much smaller than any hitherto recorded. It is shown as figure E9, plate ix. The smallest oval in the Shaw collection is 10·1 mm. long, 6·4 mm. wide and 2·9 mm. thick, and weighs ·2 grams. It is shown in figure E11, plate ix.

Thanks are due to Messrs. J. A. Tillett, H. E. Powell, F. E. Brice, and R. F. Brand for their painstaking assistance in the preparation of the plates.

XIII. SUMMARY AND CONCLUSIONS.

The collection of australites (tektites) made by Mr. W. H. C. Shaw, of Perth, W.A., has been classified and described.

A basis of classification and simple nomenclature is set out, and the distribution of forms and weights is analysed.

The general external structures of the 3,920 pieces in this collection are described and commented upon.

The distribution of australites on the streamless limestone Nullarbor Plains is described.

The evidence of this collection supports the idea that australites are glass meteorites, that they all fell at one time, in a pre-historic period, and that they were fairly evenly distributed over the area concerned.

It appears also that australite forms and structures should be considered from two distinct points of view:—*(a)* the primary or original forms of glass blebs, with their internal flow-lines and gas bubbles, and *(b)* the secondary forms due to fusion and flow of the glass on the front portion of the bodies, forming flanges, rims, and flow-ridges. The primary forms may be due to extra-terrestrial happenings, and the secondary forms to a spinning flight through the earth's atmosphere.

DESCRIPTION OF PLATES.

Plate IV.

Australites. Button types, natural size; top, bottom and side views.

Plate V.

Australites. Lens, oval, and boat types, natural size; top, bottom, and side views.

Plate VI.

Australites. Canoe, dumbbell, and teardrop types, natural size; top, bottom and side views.

Plate VII.

Australites. Lens type, reduced in scale; 623 of the 1,094 lens forms in the Shaw collection are shown.

Plate VIII.

Australites. Various unusual and aberrant forms and fragments.

Plate IX.

Various types of Australites. Natural size. To illustrate structural and surface features.

THE BLUE METAL LIMESTONE AND ITS ASSOCIATED BEDS

BY T. A. BARNES, B.SC. AND A. W. KLEENMAN, B.SC.

Summary

The main localities of the Blue Metal Limestone have been ably described by Professor Howchin[1] in his paper on the Adelaide Series. He has there given a list of the places in which the Blue Metal may be found and its general position in the Adelaide Series. The object of the present writers was to take the Blue Metal Limestone in a type locality, and by mapping to determine its thickness and associated beds and its general relations to the Thick Quartzites below and the Glen Osmond and Mitcham quartzites above. The area chosen was a portion of the foothills between Burnside and Glen Osmond. For detailed, mapping of the Blue Metal Series, Goldsack's Quarries at Beaumont was chosen, as here the dip is sensibly constant. Analyses were made of the "limestone" from various localities.

THE BLUE METAL LIMESTONE AND ITS ASSOCIATED BEDS

By T. A. Barnes, B.Sc., and A. W. Kleeman, B.Sc.

[Read July 12, 1934.]

The main localities of the Blue Metal Limestone have been ably described by Professor Howchin[1] in his paper on the Adelaide Series. He has there given a list of the places in which the Blue Metal may be found and its general position in the Adelaide Series. The object of the present writers was to take the Blue Metal Limestone in a type locality, and by mapping to determine its thickness and associated beds and its general relations to the Thick Quartzites below and the Glen Osmond and Mitcham quartzites above. The area chosen was a portion of the foothills between Burnside and Glen Osmond. For detailed mapping of the Blue Metal Series, Goldsack's Quarries at Beaumont was chosen, as here the dip is sensibly constant. Analyses were made of the "limestone" from various localities.

At Beaumont a section was run across the outcrops of the limestone and the vertical succession of beds obtained, as set out in detail in the following table, where the thickness of each band is indicated:—

	Glen Osmond Clay Slates	1,540 ft.
13.	LIMESTONE	1 ,,
	Phyllites	12 ,,
12.	LIMESTONE	4 ,,
	Phyllites	47 ,,
11.	LIMESTONE	9 ,,
	Phyllites	20 ,,
10.	LIMESTONE	2 ,,
	Phyllites	31 ,,
9.	LIMESTONE	1 ,,
	Phyllites	2 ,,
	Quartzites	3 ,,
	Phyllites	8 ,,
	Quartzites	9 ,,
	Phyllites	12 ,,
8.	LIMESTONE	2 ,,
	Phyllites	4 ,,
7.	LIMESTONE	2 ft.
	Phyllites	5 ,,
	Quartzite	7 ,,
	Phyllites	14 ,,
6.	LIMESTONE	1½ ,,
	Phyllites	5 ,,
5.	LIMESTONE	2½ ,,
	Phyllites	4 ,,
4.	LIMESTONE	1 ,,
	Phyllites	58 ,,
3.	LIMESTONE	3 ,,
	Calc. Phyllites	10 ,,
2.	LIMESTONE	6 ,,
	Phyllites	69 ,,
1.	LIMESTONE	15 ,,
	Lower Phyllites	1,000 ,, (?)

The base was taken at the bottom of the main 15-foot bed which is exposed in the western quarry. The top was a thin limestone which forms a rather inconspicuous outcrop near the top of the hill almost directly south of the eastern quarry. This is 370 feet stratigraphically above the datum. In this thickness is included 49 feet of limestone and 3 bands of quartzites. The remainder of the rocks may be styled calc-phyllites. The phyllites do not outcrop as the quartzites and limestones do. The phyllite where seen varies from an almost argillaceous type to some which becomes blue in colour and passes into argillaceous limestone. These highly calcareous types are the metamorphosed equivalents of marls.

From this type locality the Blue Metal beds can be followed in a north-easterly direction and across a small stream and up on to the opposite hillside, where they suddenly cut out against a bar of quartzite. This was considered a fault breccia by Professor Howchin. A very similar rock has been seen by the

(1) Howchin, W., "Geology of the Mount Lofty Ranges; Part II. (The lower and basal beds of the Cambrian"); Proc. Roy. Soc., vol. xxx., 1906, pp. 227-262.

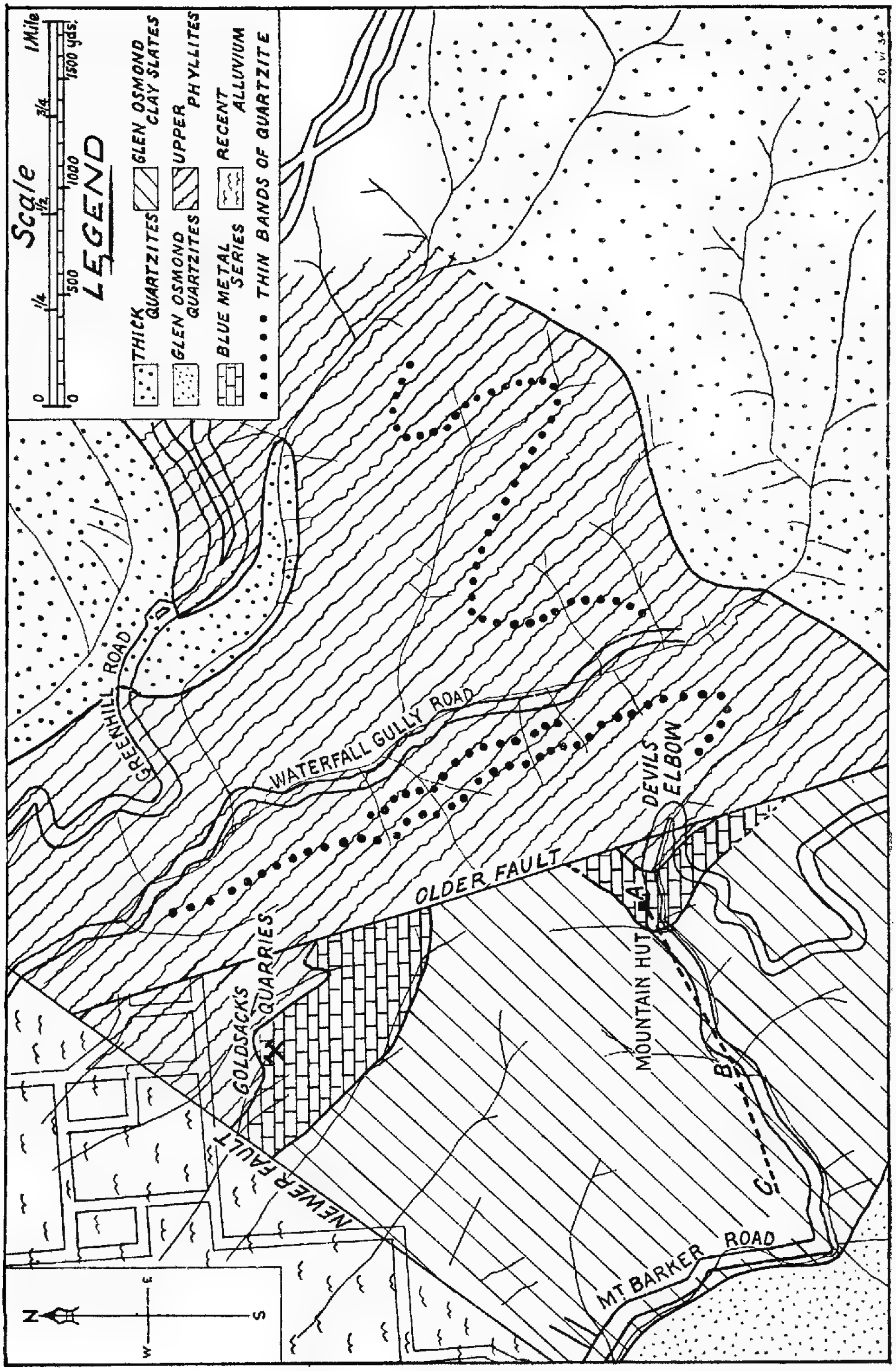

Fig. 1.
Locality Map.

writers filling a fault cutting the Blue Metal north of Stonyfell quartzite quarries. The main bed can be traced westward a short distance before it is lost beneath the alluvium which covers the main fault scarp bounding the Adelaide Hills. The thick bed near the top of the series can be seen on the south side of the valley south of Goldsack's quarries. It can be traced in a south-easterly direction, making a bold outcrop till it suddenly disappears. Another band can be seen on the north side of this valley, and ceases along the same line as the other two outcrops (see map, fig. 1).

The main beds of the Blue Metal are again well seen in the quarries near Mountain Hut on the Mount Barker Road. The bands corresponding to bands II. and III. in the Beaumont area are seen in two small quarries opposite the Mountain Hut and in a cutting behind the stables attached to Mountain Hut. The beds can be traced by surface outcrop and a line of small pits to a large quarry 200 yards N.70°E. of the Mountain Hut. There is no trace of the limestone north or east of this point. Tracing the beds to the south, they appear again in a large quarry 200 yards from the Devil's Elbow on the southern side of the hairpin bend. From here they can be traced around the flank of the hill to another quarry 350 yards due south of the Devil's Elbow. Here they are lost again. In this section the succession of beds is very similar to that at Beaumont.

Diligent search was made for the Blue Metal between Burnside and the Devil's Elbow and south of the latter locality, but without success. Accordingly, on this evidence, and the evidence of the fault breccia at Beaumont, the writers have postulated a fault striking N.10°W., which has caused the western block to move down relative to the eastern block.

For this reason, in the area under discussion, it was found impossible to find the relations and thickness of strata between the Blue Metal and the Thick Quartzite. The relation between the Blue Metal and the Glen Osmond and Mitcham Quartzites can best be seen in a section E.-W. along the Mount Barker Road from Mountain Hut to the Glen Osmond quartzite quarries. The section on the south side of the road is difficult to follow owing to lack of outcrops. Accordingly a section, line A.B.C. on map, was run along the road from the Mountain Hut to the private road to Mount Osmond Club House (fig. 2). The section then follows this road

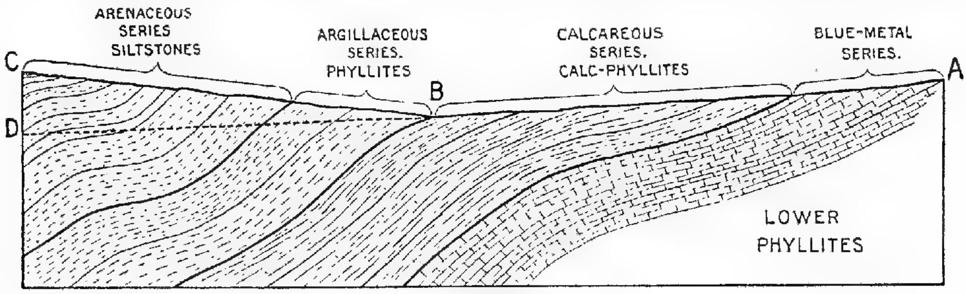

Fig. 2.

Section of the Glen Osmond Slates, showing the variation in character and dip. Length of section, 750 yards.

along the side of the hill and finally ends when the road turns north. The typical Glen Osmond quartzite does not occur here, but the section ends in a silty rock which immediately underlies the quartzite on the south side of the road. This spot is at the same height and on the same line of strike as similar beds on the south side of the valley. The contact between the phyllites and the quartzites can be seen in the Unley Corporation quarry and on the hillside east of the quarry. The quartzite which is more or less flat bedded in the floor of the quarry, changes

rapidly, till on the east face of the quarry the bedding is almost vertical. A hundred feet higher, and to the east, they are dipping to the east at an angle of 30°. Traced eastward they become horizontal and again dip westward, and finally become vertical and pass out of the top of the ridge. The beds immediately below the main quartzite are silty and soft sandstones. The phyllites between the Blue Metal and the quartzites exhibit a sequence. The beds just above the Blue Metal are calcareous-phyllites with a few interbedded thin limestones. These semi-calcareous beds occupy 440 feet above the Blue Metal. Above these come 370 feet of argillaceous rocks without the thin limestones. Then follows 670 feet of silty rocks, which suggest a gradual development of the conditions which lead to the quartzite.

The beds below the Blue Metal are cut off by the fault. The beds above the Thick Quartzite have been mapped in between the Thick Quartzite and the fault line. The junction of the Upper Phyllites and the Thick Quartzite is very disturbed, and it is possible that faulting has occurred along the junction in the Waterfall Gully area. The beds, as they approach the Waterfall from the west, become folded to the east, and on the south side just below the fall can be seen to be dipping at a high angle to the east. The Waterfall Gully runs approximately parallel to the strike of the beds, so that a traverse along it shows very little. High up on the north side of the gully is a quartzite with which is associated a blue limestone. This same bed can be seen, with its associated limestone, at a much lower level on the south-west side of the road. It is well seen just above the pump house that pumps the water up to Mount Osmond Golf Course. A hundred feet above this comes another quartzite, associated with a thin cream-coloured dolomite. (Howchin, *op. cit.*, p. 241.) This quartzite runs from the fault line at Beaumont in a south-easterly direction, parallel with the road, and gradually rising up the ridge until it passes over the top of the ridge and works back into Leawood Gardens on the south side of the ridge.

The Blue Metal was examined in places outside the area mapped. It was thought that it might be possible to link up the outcrop of Blue Metal in the Brownhill Creek with that at Glen Osmond. However, a brief examination of the beds showed that the direction of dip had changed from S.75°W. at Burnside to S.E. in the Brownhill Creek. This indicates a break in the tectonics between the two areas. The Brownhill Creek area cannot be treated as an extension of that at Burnside, but presents a problem of its own. The boundary of the two blocks is probably not far south of the southern edge of the area mapped in. The succession of beds in the Blue Metal series in this locality is similar to that at Beaumont. Commencing with a thick limestone 20 feet thick, there are over 300 feet of calcareous series containing in all 50 feet of limestone.

The Blue Metal was examined in the Stonyfell area. Here the beds are disturbed, being folded and faulted, and it is impossible without much detailed work to do more than repeat what Professor Howchin has said of this area (*op. cit.*, p. 238). Here, too, the relationship between the Blue Metal and the Thick Quartzite cannot be observed, as there is a major fault line which cuts off the Thick Quartzite in the western side of Dunstan's Stonyfell quarry and has let down the Blue Metal Limestone, which is about 1,000 feet above the top of the Thick Quartzite, level with the base of the Thick Quartzite. This fault is thus of a large order of magnitude. Professor Howchin noticed this fault (*op. cit.*, p. 243), but apparently did not record its significance with regard to the Blue Metal.

Petrography.

The Blue Metal limestone is a hard dark blue rock with an imperfect conchoidal fracture. It is very fine grained, no crystals being visible to the naked eye except occasional crystals of black dolomite. At some horizons the beds contain

nodules of chert, and there may be a thin layer of chert above a bed. Under the microscope the rock is seen to consist of a mass of small subidiomorphic crystals of dolomite with irregular aggregates of quartz. The dolomite crystals are very even in size, ·006—·007 mm. The quartz is in relatively large flaky areas which have recrystallized to grains about ·025 mm. These aggregates have not the clear cut edges which would result if they had simply been recrystallized adventitious grains of quartz, but are intergrown with the dolomite crystals in such a way as to suggest precipitation as colloidal silica, or as opal by radiolaria, and recrystallization simultaneous with the dolomitisation of the rock. The other constituents are pyrites and haematite and muscovite. The mica is in very small flakes.

A complete analysis of the Blue Metal limestone from the main band at Beaumont was carried out by one of the writers (T. A. B.) with the following results:—

SiO_2	28·15	Alkalies	0·89
TiO_2	·10	CO_2	31·95
Al_2O_3	1·13	P_2O_5	0·13
Fe_2O_3	0·54	H_2O+	0·01
FeO	0·34	H_2O-	0·13
MnO	0·01	FeS_2	1·22
CaO	21·18		
MgO	14·54	Total	100·32

In addition the following partial analyses were made:—

No.	13	3A	8	2	9	17	U.T.L.	L.T.L.
SiO_2	27·5	27·6	24·7	22·0	5·1	30·1	24·9	29·0
Al_2O_3, etc.	3·4	3·0	2·7	3·4	3·5	5·7	3·3	2·4
CaO	21·7	22·9	23·9	24·5	44·8	19·1	21·8	20·1
MgO	14·7	15·1	15·4	16·2	6·1	13·9	17·0	16·3
CO_2	33·1	32·1	33·4	n.d.	39·9	31·9	33·2	32·2
	100·4	100·7	100·1	——	99·4	100·7	100·2	100·0

13 Quarry 200 yards N.70E. of Mountain Hut.—Analyst, T. A. B.
3A Quarry 350 yards south of Devil's Elbow.—Analyst, T. A. B.
8 Quarry on creek north of Goldsack's Quarry.—Analyst, T. A. B.
2 Big quarry 200 yards up Mount Barker Road from Devil's Elbow.—Analyst, A. W. K.
9 Limestone outcrop, 1,200 yards S.10°W. of Goldsack's Quarries.—Analyst, T. A. B.
17 Limestone interbedded with slates near spot B on map.—Analyst, T. A. B.
UTL Upper Torrens limestone—Torrens Gorge, near Sixth Creek.—Analyst, T. A. B.
LTL Lower Torrens limestone—Torrens Gorge, near Deep Creek.—Analyst, T. A. B.

These analyses show remarkable similarity between the main Blue Metal Limestone over the whole area. The high silica percentage occurs as free quartz in the slide. The carbonate portion is purely dolomite; thus the rocks would be more truly classed as dolomites. The inclusions of the analyses of the two Torrens limestones is for comparative purposes. It was thought that some distinction might be made between the Blue Metal and Upper Torrens Limestones on chemical grounds. There seem to be no essential differences, the higher percentage of magnesia in the Upper Torrens limestone being due to weathering, which in these areas tends towards the formation of magnesite. Nos. 9 and 17 are representative of the upper beds above the Blue Metal Series. No. 17 is quite regular, except for a greater percentage of clay. No. 9 is composed entirely of large

crystals of black calcite with curved crystal faces which give an unusual appearance in hand specimen. It forms an inconstant band.

The tectonics of this small area are intimately bound up with the large scale movements which built up the Mount Lofty Ranges, and cannot be fully explained until much more is known of the structure of these ranges. The north-western and western boundary of the area is a natural one, an important fault scarp bounding the ranges there, possibly the western fault of the Belair Block (Fenner, Proc. Roy. Soc. S.A., vol. li., 1927, p. 217, *et seq.)*. The northern boundary is quite arbitrary, and the area to the northward is the natural extension of this area. The southern boundary marks the beginning of an important break in the structure of the ranges. The eastern boundary is the thick quartzite which extends eastward to Mount Lofty. This boundary is also a junction plane of some complexity. The dominant feature of the area is the fault which runs across the area and cuts it into two separate parts, which must be considered separately. No idea could be gained of its magnitude, as no one bed can be seen on both sides of the fault. West of the fault the beds immediately associated with the blue metal have a dip of 26° in direction S.75°W. The higher beds, as they come nearer to the Mitcham Quartzites, roll and pass under the quartzites in step-like folds, with the downthrow to the west. The beds on the eastern side of the fault are of fairly uniform dip, 20°-25° in direction S.80°W., but as they pass toward the disturbed area they flatten and then dip east at a high angle.

The folding and faulting of the area appears to be, in part, very ancient, and is possibly of Cambrian Age. The area had then been eroded to a peneplain before the Tertiary uplift and block faulting. Thus the topography is of a complex nature. The longer streams are antecedent streams modified by the uplift, and the smaller ones are subsequent, draining the edge of the fault scarp.

The Blue Metal Limestone has been mapped in a type locality and shown to occupy a broad zone of 370 feet of calcareous series, of which 49 feet is blue metal. The limestone is chemically a dolomite. Above the Blue Metal Series is 1,500 feet of the Glen Osmond Clay Slates, which underlie in turn the Glen Osmond and Mitcham Quartzites.

A PRELIMINARY ACCOUNT OF THE COLLEMBOLA-ARTHROPLEONA OF AUSTRALIA.
PART II. -SUPERFAMILY ENTOMOBRYOIDEA.

BY H. WOMERSLEY, A.L.S., F.R.E.S.

Summary

As with the Poduroidea, this superfamily of the Collembola has been little studied in Australia, doubtlessly because of its apparent lack of economic importance. That some species, at least, are potential pests will be seen from the few cases mentioned later.
The first record of this group from this country is that of *Isotoma troglodytica (Proisotoma minuta* Tullberg), described by Rainbow in 1907 (26). The remainder of the hitherto known forms were those recorded or described by Schott (28) from the Mjöberg material. In this collection were 33 species.

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PART II.—SUPERFAMILY ENTOMOBRYOIDEA.

By H. WOMERSLEY, A.L.S., F.R.E.S. (Entomologist, South Australian Museum).

[Read August 9, 1934.]

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In the present paper, 78 species are recorded (3 as varieties only), of which 31 species are new, and no fewer than 27 are well-known forms, previously unknown from Australia. Three new genera are described.

Although even now the Collembolan fauna of Australia can be but partly known, especially in the northern parts, the numbers of species in the three main divisions are as follows:—

Symphypleona - - - -	47
Arthropleona-Poduroidea - -	33
„ Entomobryoidea -	91
	171

This total is only a little less than that of the species known for Europe.

Economic Importance of the Entomobryoidea.

Although the economic importance of the Collembola is as yet very little realized, except in one or two cases, the list of injurious species is gradually growing. In a recent publication Folsom (110A) has listed 43 species definitely injurious to crops. Of these, 16 belong to the group discussed in this paper, and 7 of them are now known to occur in Australia.

During the past few decades, there has been a tendency on the part of those who provide the money for research to ignore the pure collector and systematist and to concentrate only on the economic aspect. The fact that many species of Collembola present in Australia are either native of, or at least occur in, the more settled countries, should emphasise the importance and need for a thorough systematic and faunistic study of all insect orders. Hitherto, owing to the lack of this knowledge, much valuable time has been lost and money needlessly spent before the identity of a pest has been decided and its native country ascertained. Especially is this important in that field of entomological research known as Biological Control. Only in the native home of a pest can one hope to find controlling agencies, and many cases could be mentioned where, had a detailed faunistic knowledge been available, the obtaining of suitable parasites or predators would not have been such a blind and prolonged procedure.

[Part I. of this work was published in the Proceedings of the Royal Society of South Australia, vol. lvii., 1933, pp. 48-71. Note also "A preliminary account of the Collembola-Symphypleona of Australia," by the same author, C.S.I.R. pamphlet 34, 1932.—ED.]

The "Lucerne Flea," although known to occur in Australia since 1884, was not definitely determined as the *Sminthurus viridis* of Europe until recent years. Its predatory enemy, *Biscirus lapidarius*, a European species, was found to be a controlling agent first in Western Australia. The group of mites (Bdellidae) to which it belongs has only recently been systematically surveyed in Europe, and not at all in England. The knowledge derived from a proper regional survey of this group of mites in those countries would have enabled the economic entomologist to consider the use of this mite as soon as the necessity of a control of a biological nature became apparent.

In Hawaii two outstanding examples may be mentioned. The native country of the Sugar-cane Leaf-hopper, *Perkinsiella saccharicida* was unknown for some years after it had become a pest. Subsequently, after a long and blind search, it was discovered in Queensland, where it was controlled by a number of small wasps. These parasites were then introduced with success into Hawaii. A knowledge of the Homoptera fauna of Australia would, therefore, have saved time and money. Similarly, search for the native home of the Sugar-cane borer beetle *Rhabdocnemis obscura*, was made in many parts of the world before it was finally located in Amboina along with its parasitic Tachinid flies. The protracted studies in Mexico of the insect enemies of the Prickly Pear by Prof. Johnston and his successors might have been available before the plant had reached the pest stage in Australia.

These few examples will serve to emphasise my contention that the systematic study of the insect fauna of all countries, while necessarily coincident with economic studies, is essentially fundamental to the work of the economic entomologist. The tendency to ignore the systematist must give way and a proper perspective taken of his work as it affects the practical control of insect pests.

Superfamily ENTOMOBRYOIDEA.

= Entomobryomorpha Börner, 1913.

Family ISOTOMIDAE (Schäffer, 1898; Börner, 1913).

Subfamily ISOTOMINAE (Schäffer, 1898; Börner, 1913).

Tribe Anurophorini Börner, 1906.

Genus Cryptopygus Willem, 1902.

This genus is essentially a primitive one, which, except for a single species from New Zealand, was hitherto known only from the Subantarctic Regions. The species are very close and can only be separated by minute characters such as the number of ocelli, the form of the postantennal organ and the structure of the mucrones. Two species are now described from Australia, and a key given for all known forms.

Cryptopygus australis, n. sp. (Text fig. 1, *a-f*.)

Description.—Length 0·7 mm. Colour, light-brown, mottled, with well separated darker spots. Antennae very little longer than the head, segments I. : II. : III. : IV. = 10 : 11 : 11 : 21, IV. with small eversible apical lobe. Antennal organ III. as in figure 1 *b*. Ocelli, 8 on each side on deeply pigmented patches. Postantennal organ broadly oval, two and a half times as long as an anterior ocellus. Relative lengths of body segments in medio-dorsal line = th. II. : III. : abd. I. : II. : III. : IV. : V. = 35 : 25 : 25 : 25 : 25 : 16 : 15, abdomen VI. hidden under V. Claws simple, without inner teeth. Empodial appendage with inner and outer narrow lamellae. Tibiotarsus with two fine clavate hairs. Furca short, ratio of dens to mucro = 4 : 1, dens broad and thick, mucro apically tridentate. Clothing consisting of short fine setae.

Locality.—You Yang Mountains, Victoria, collected by Miss J. W. Raff.

Type in the South Australian Museum.

Cryptopygus loftyensis, n. sp. (Text fig. 1, *i.-m.*)

Description.—Colour, entirely blue. Antennae slightly longer than the head, ratio of segments = 17 : 25 : 23 : 37, IV. with small terminal exsertile knob, organ III. normal. Ocelli, 8 on each side, equal, on dark patches. Postantennal organ elliptical, equal to two ocelli. Ratio of body segments along medio-dorsal line = th. II. : III. : abd. I. : II. : III. : IV. : V. = 40 : 40 : 25 : 30 : 32 : 46 : 30; VI. hidden under V. Claws with inner tooth slightly beyond the middle. Empodial appendage with broad inner lamella. Tibiotarsus with two fine clavate hairs. Furca longer than in preceding species, ratio of manubrium : dens : mucro = 30 : 23 : 7, dens tapering, mucro with apical and subapical teeth and narrow inner lamella. Clothing of simple setae, uniform, more numerous than in preceding species.

Localities.—Syntypes in moss, Mount Osmond, South Australia, June 9, 1934 (H. W.); others in moss, Mount Barker, South Australia, June 24, 1934 (H. W.).

Syntypes in South Australian Museum.

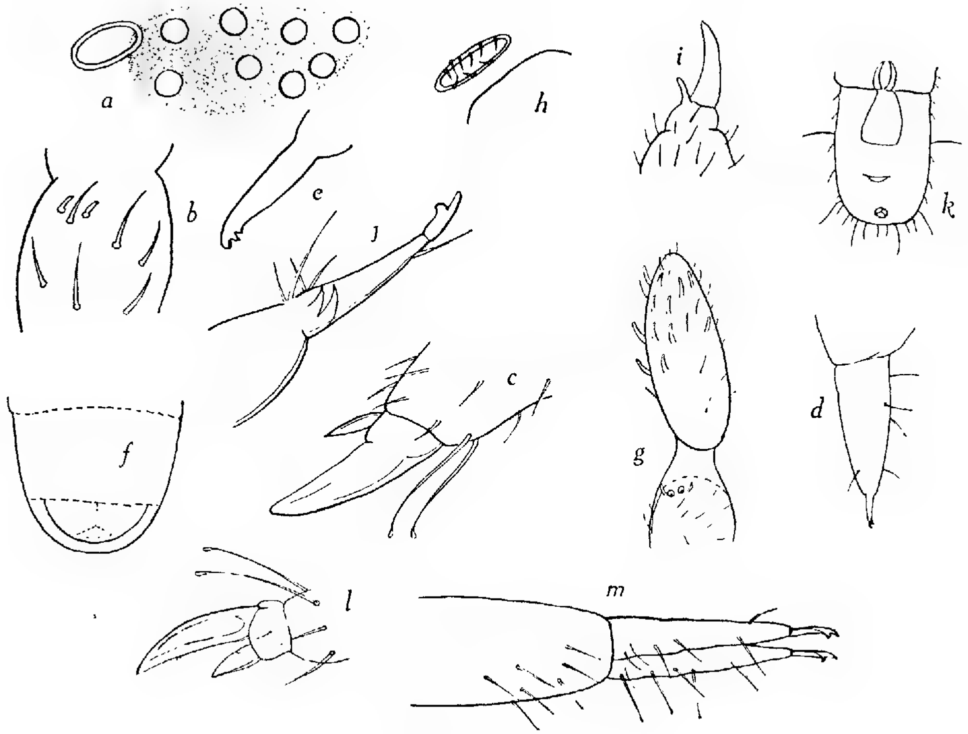

Fig. 1.

a. *Cryptopygus australis,* n. sp. Ocelli and postantennal organ.
b. " " " " Sensory organ on ant. III.
c. " " " " Tip of tibiotarsus.
d. " " " " Furca from side.
e. " " " " Mucro enlarged.
f. " " " " Apical abdomen segments from below.
g. *Isotomodes productus* (Axels.) Tip. of ant. III. and whole of IV.
h. " " " Postantennal organ.
i. " " " Tip of tibiotarsus and claw.
j. " " " Furca.
k. " " " Apical abdom. segments from below.
l. *Cryptopygus loftyensis,* n. sp. Tip of tibiotarsus and claw.
m. " " " " Furca.

Key to the Known Species of Cryptopygus Willem.

1.	Ocelli, fewer than 8 on each side. P.a.o. crescentic or elliptical.	3
	Ocelli, 8 on each side. P.a.o., oval.	2
2.	Mucro with three subapical teeth. P.a.o. three to four times as long as an anterior ocellus.	*C. australis*, n. sp.
	Mucro with subapical and apical teeth only.	*C. loftyensis*, n. sp.
	Mucro with only a blunt apical tooth.	*C. niger* Carp, 1925 (New Zealand).
3.	Ocelli absent. Mucro tridentate, distal tooth about the middle. Tibio-tarsus without clavate hairs. Colour, white.	*C. coecus* Wahlgren, 1906 (Subantarctic).
	Ocelli, 6 or 7 on each side.	4
4.	Ocelli, 7 on each side. P.a.o., crescentic. Clavate tibiotarsal hairs present. Mucro, bidentate. Colour, blackish.	*C. antarcticus* Willem, 1902 (Subantarctic).
	Ocelli, 6 on each side.	5
5.	Clavate tibiotarsal hairs absent. Colour, mottled bluish-black.	*C. cinctus* Wahlgren, 1906 (Subantarctic).
	Clavate tibiotarsal hairs present. Colour, bluish-violet.	*C. crassus* Carp., 1905-6 (South Orkneys).

Genus Isotomodes (Axels.) Linnaniemi, 1907.

Syn. *Isotoma* Axels. 1903 (ad partem).

Isotomodes productus (Axels., 1907). (Text fig. 1, *g.-k.*)

= *Isotomo elongata* Axels., 1903 (nec. McGillivray, 1896); *Isotoma producta* Axels., 1906; *Isotomodes productus* Axels., 1907.

Description.—Length, to 1·0 mm. White. Antennae short, about one-fourth as long as the head. Body elongate, ratio of abdominal segments = 4 : 6 : 5 : 6 : 6 : 4. Antennae IV. with subapical papilla and 6 olfactory hairs. P.a.o. large, broadly elliptical and not notched. Ocelli absent. Furca short, not reaching abd. II. Dentes not annulated, with 2 dorsal and 2 ventral setae. Mucro one-fourth the length of dens and with two strong teeth. Clothing short and sparse, simple.

Localities.—Under deeply embedded stones at Chittering, Western Australia, October 10, 1931 (H. W.); similarly on Mount Osmond, South Australia, in 1933 (H. W.).

Remarks.—This is a well-known but rare European species, and may possibly be considered as an introduction to Australia by means of plant soil.

Genus Folsomia Willem, 1902.

Syn. *Isotoma* Tullberg, 1897 (ad partem).

Folsomia fimetaria (Linn., 1758), Tullbg., 1872. (Text fig. 2, *a.*)

= *Podura fimetaria* Linn., 1758; *Isotoma alba* Tullbg., 1871; *Folsomia candida* Willem, 1902; *Isotoma splendens* Becker, 1902.

Description.—Length, 1·0-1·5 mm. Colourless and blind. Clothing of short, thick hairs. Antennae slightly longer than the head. Antennae IV. with subapical papilla and olfactory hairs. Antennal organ III. with 2 curved sensory rods and 2 guard setae. P.a.o. long and narrow with parallel edges, not curved. Claws unarmed, seldom with inner tooth. Empodial appendage lanceolate.

Clavate tibiotarsal hairs absent. Mucro as long as hind claw, with two teeth, one distal and one apical.

Locality.—Riddell, Victoria, on March 14, 1931 (H. G. A. and H. F. D.).

Remarks.—Probably an introduction from Europe, where it is a common species under loose boards, stones or in soil. It is also recorded from the Nearctic Region, and will probably be found to be widely distributed in cultivated parts of Australia.

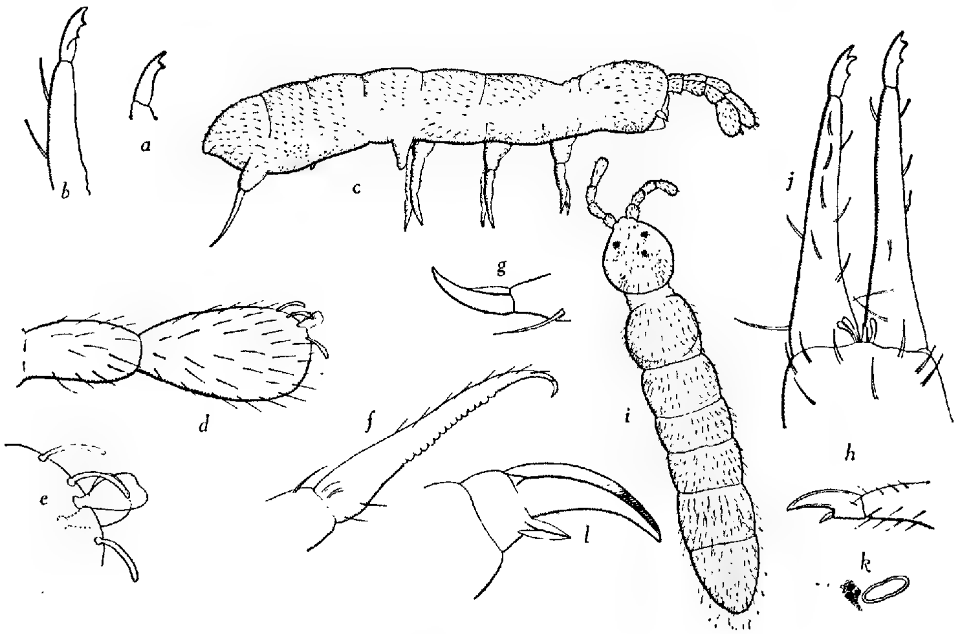

Fig. 2.

a.	*Folsomia fimetaria* (Linn.)	Mucro, side view.
b.	„ *fimetarioides* (Axels.)	Tip of dens and mucro.
c.	*Folsomina onychiurina* Denis	Entire animal.
d.	„ „ „	Ant. III. and IV.
e.	„ „ „	Sensory organ on ant. IV.
f.	„ „ „	Dens and mucro.
g.	„ „ „	Mucro.
h.	„ „ „	Tip of tibiotarsus and claw.
i.	*Folsomia loftyensis,* n. sp.	Entire animal, dorsal view.
j.	„ „ „ „	Furca.
k.	„ „ „ „	Ocelli and p. a. o.
l.	„ „ „ „	Foot.

Folsomia fimetaroides (Axels., 1903). (Text fig. 2, *b.*)

= *Isotoma fimetaroides* Axels., 1903.

Description.—Length, 1·8 mm. White and blind. Antennae as long as head, IV. with 10 olfactory hairs, subapical papilla and terminal knob. P.a.o. narrow and doubly contoured. Claws unarmed. No clavate tibiotarsal hairs. Abd. IV.-VI. fused. Furca not quite reaching ventral tube. Dens twice as long as manubrium, distally curved and annulated. Mucro with three teeth.

Localities.—Sherbrook, Victoria, April 19, 1931 (H. G. A. and H. F. D.); September, 1931 (H. F. D.); Sassafras, Victoria, December, 1931 (H. G. A.).

Remarks.—This species differs little from the preceding except in the dentition of the mucro. It is also possibly an introduction from Europe, where it has been recorded from Finland, Switzerland, and England.

Folsomia loftyensis, n. sp. (Text fig. 2, *i.-l.*)

Description.—Length to 1·5 mm. Colour, whitish-grey, with slight patches of dark pigment on head and laterally on body. Ocelli, 3 on each side close together in a triangle, deeply pigmented on small dark patches. Post-antennal organ large, quite three times as long as the whole ocellar patch, doubly contoured and notched on each side. Antennae slightly longer than head, ratio of segments = 12 : 18 : 18 : 32, IV. with terminal knob, antennal organ III. indeterminate. Thorax II. and III. subequal. Abdomen IV. slightly longer dorsally than III. Claws simple, unarmed. Empodial appendage with inner and outer lamellae. Furca short, not reaching abd. II.; ratio of dens to mucro = $5\frac{1}{2}$: 1; mucro tridentate *(cf.* fig.); dentes ventrally with spines. Abdomen IV.-VI. fused. Anus slightly ventral. Clothing of long fine setae.

Locality.—Long Gully, Mount Lofty Ranges, South Australia, May, 1934 (H. W.).

Syntypes in the South Australian Museum.

Remarks.—Differs from *Folsomia sexoculata* Tullbg. in the arrangement of ocelli and the tridentate mucro.

Genus Folsomina Denis, 1932.

This very interesting genus is closely allied to *Folsomia* Willem, but differs in the falciform mucro, the absence of a postantennal organ and in the complicated structure of the subapical sensory organ on the fourth antennal segment.

Folsomina onychurina Denis, 1932. (Text fig. 2, *c.-h.*)

Description.—Length, 0·6-0·7 mm. Colour, white. Ocelli and p.a.o. wanting. Antennae slightly longer than the head, ratio of lengths of antennal segments = 8 : 10 : 12 : 20, IV. twice as broad as III., subapically with a complex sensory organ consisting of two large scale-like lobes, behind which are two strongly curved olfactory hairs and in front another one. Antennal organ III. consisting of two rods or tubercles flanked by two olfactory hairs. Claws unarmed, five times as long as mucro. Empodial appendage distinct with narrow outer and broader inner lamella. Clavate tibiotarsal hairs absent. Furca rather short, ratio of manubrium to mucrodens = 17·5 : 30, dens tapering and annulated, mucro falciform with a slight inner basal lamella. Clothing of short, sparse, simple setae.

Localities.—Nangara, Western Australia, November 11, 1930 (B. A. O'C.); in hothouse, Government Gardens, Perth, Western Australia, February 10, 1930 (B. A. O'C.).

Remarks.—This genus and species was only described in 1932 from two specimens collected in Costa Rica in 1911. Its occurrence in Australia is remarkable, and while its capture in a hothouse may point to its being an introduction, the Nangara locality may be a perfectly natural one. No details of the habitat in which it occurred in Costa Rica are given.

Genus Axelsonia Börner, 1907.

Syn. *Isotoma* Moniez, 1890 (ad partem).

Axelsonia littoralis (Moniez, 1890). (Text fig. 3, *a.-e.*)

= *Isotoma littoralis* Moniez, 1890; *Isotoma nitida* Folsom, 1899; *Axelsonia thalassophila* Börner, 1906; *Axelsonia littoralis* Denis, 1924.

This is a typical shore-inhabiting form and lives on decaying molluscs and barnacles. It is to be found in numbers in the crevices of rocks lying between high and low water, and can withstand immersion to a considerable depth. Previously it has been recorded from France, Japan and the Seychelles. The genus, which is monotypic, is separated from the other genera of the Isotominae on the following characters: abdomen II.-IV. with 2 pairs of fine sensory setae (Bothriotrichiae). P.a.o. absent. Clavate tibiotarsal hairs absent. Claw on outside with two long lancet-like processes. Antennae III. with 15-20 sensory rods. Colour, greyish-green.

In Australia this species has been found in the following localities:—Longreach Bay, Rottnest Island, Western Australia, January, 1931 (L. J. G.); Point Perron, Western Australia, April 6, 1931 (H. W.); King River Estuary, Western Australia, January, 1932 (H. W.).

Genus **Acanthomurus,** n. gen.

Allied to *Isotomurus,* but differing in that the dentes are armed ventrally with numerous slightly curved setae which are strongly serrated on one side. The body setae are strongly ciliated and not simple.

Genotype = *Acanthomurus plumbeus,* n. sp.

Acanthomurus plumbeus, n. sp. (Text fig. 3, *f.-j.*)

Description.—Length, 2·7 mm. Colour, blue-black, except anterior margins of segments, which are yellowish. Antennae and legs, except trochanters and base of femora, blue-black. Furca, yellowish with a tinge of blue at base of manubrium. Antennae nearly three times as long as head; ratio of segments = $1 : 4 : 4 : 4\frac{1}{4}$. Ocelli, 6 on each side on dark patches. P.a.o. small, elliptical, less than half an ocellus in diameter. Antennal organ III. as in figure 3, *g.* Legs long; claws with two inner teeth, one slightly beyond the middle, the other more distal, and a basal lateral tooth. Empodial appendage long, reaching past the first tooth of the claw, with broad outer lamella reaching the tip and slightly narrower lamella on inside for one-third of its length; the latter lamella with a very prominent inner tooth. Clavate tibiotarsal hairs absent. Furca reaching ventral tube; ratio of manubrium to mucrodens = $1 : 2\frac{1}{2}$, mucro less than one-fourth the length of hind claw and with four teeth. Dentes indistinctly fringed with numerous long hairs and on ventral side with short and strong, evenly curved, setae, which are serrated on one side. Length of body segments, th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. = $2\frac{1}{2} : 2 : 1\frac{1}{2} : 2 : 2\frac{3}{4} : 2\frac{1}{2} : 1\frac{1}{2} : 1$. Segments of body heavily clothed with long ciliated setae. Abdomen IV. and VI.? with sensory setae (Bothriotrichiae), as well as several equally long but stouter ciliated setae. Tibiotarsi with long setae.

Localities.—Under rotten bark at Parkerville, Darling Ranges, Western Australia, October 5, 1930 (H. W.); Mount Barker, Western Australia, June, 1931 (H. G. A.); Gooseberry Hill, Western Australia, June, 1932 (G. F. N.).

Syntypes in the South Australian Museum.

Var. **lineatus,** n. var.

Differs from the typical form in the lighter ground colour and the four longitudinal dark lines on the dorsum. Specimens were received from Launceston, Tasmania, collected by Mr. V. V. Hickman in August, 1929.

Type in the South Australian Museum.

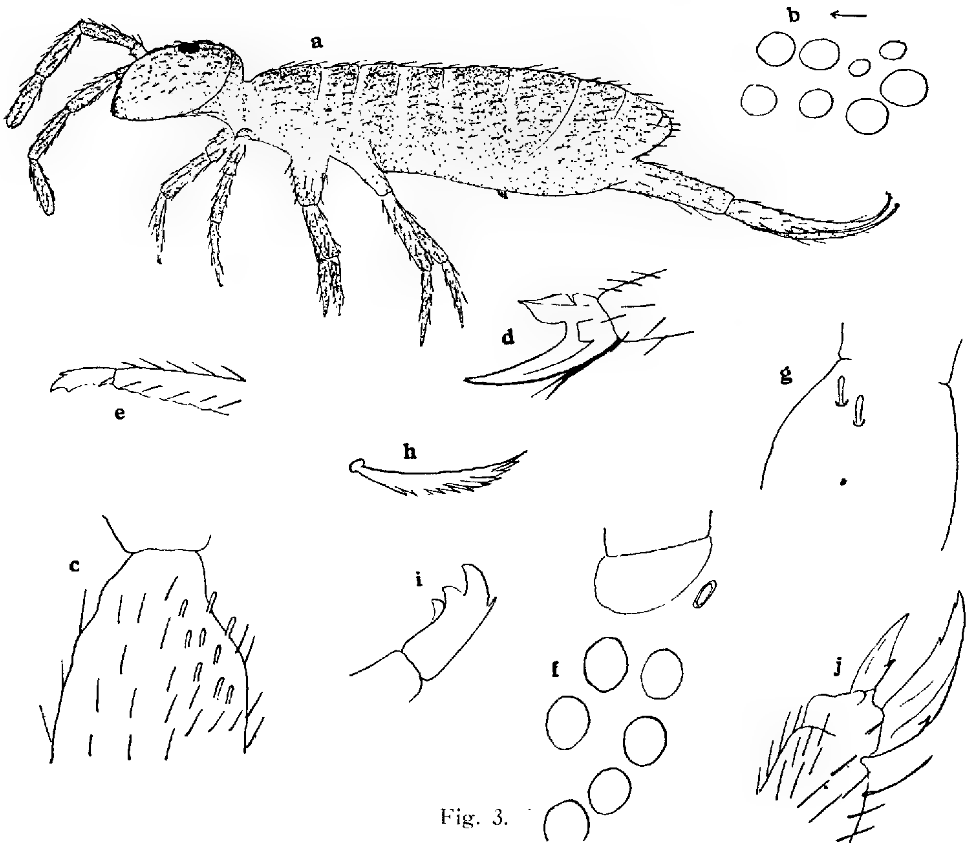

Fig. 3.

a.	*Axelsonia littoralis* (Monz.)	Entire animal.
b.	" " "	Ocelli.
c.	" " "	Tip of ant. III.
d.	" " "	Tip of tibiotarsus and claw.
e.	" " "	Mucro and tip of dens.
f.	*Acanthomurus plumbeus*, n. g., n. sp.	Ocelli and postantennal organ.
g.	" " " "	Sensory organ on ant. III.
h.	" " " "	Curved seta from ventral surface of dens.
i.	" " " "	Mucro.
j.	" " " "	Tip of tibiotarsus and claw.

Genus **Proisotomurus,** n. gen.

Allied to *Isotomurus* and *Acanthomurus* but having the dentes armed ventrally with a double row of strong, simple spines arising from very distinct papillae. These papillae would appear to connect the genus with *Agrenia* Börner. Fine sensory setae (Bothriotrichiae) are present on at least abdomen II. and III., but these are only about half as long as in the genera *Isotomurus* and *Acanthomurus.*

Genotype = *Proisotomurus papillatus,* n. sp.

Proisotomurus papillatus, n. sp. (Text fig. 4, *a-e.*)

Description.—Length, 2·6 mm. Colour as in *Isotomurus palustris* Mull., *f.p.* Antennae nearly $2\frac{1}{2}$ times the length of head, segments = $1\frac{1}{4}$: 2 : 2 : $2\frac{1}{6}$. Antennal organ III. as in fig. 4 *a*. Ocelli, 8 on each side. P.a.o. small, elliptical about half an ocellus in diameter. Ratio of lengths of body segments = th. II. : III. : abd. I : II. : III. : IV. : V. : VI. = 1 : 1 : $\frac{2}{3}$: $\frac{3}{4}$: 1 : 1 : $\frac{1}{2}$: $\frac{1}{2}$. Claws with basal lateral tooth but no inner teeth. Empodial appendage reaching to half the length of claw, pointed, with broad inner and narrower outer lamella, inner angle with small tooth. Clavate tibiotarsal hairs absent. Furca reaching beyond ventral tube; ratio of manubrium to mucrodens = $2\frac{1}{2}$: $4\frac{1}{2}$. Dentes with moderately long setae and ventrally with two rows of papillae, each armed with a long, strong spine. Mucro with four teeth. Clothing of numerous long, simple setae, although several longer setae on the middle and hind legs are ciliated. Abdomen II.-IV with fine but relatively short sensory setae.

Locality.—Guildford, Western Australia, October 6, 1930 (H. W.).

Syntypes in the South Australian Museum.

Genus Isotomurus Börner, 1903.

Syn. *Podura* Müller 1776 (ad partem); *Isotoma* Bourlet, 1839 (ad partem).

Isotomurus palustris (Müller, 1776). (Text fig. 4, *f-g.*)

= *Podura palustris* Müller, 1776; *Isotoma palustris* Tullberg, 1872; Lubbock, 1873; Reuter, 1876 (ad partem); Reuter, 1880. *Isotoma aquatilis* Lubbock, 1873 (ad partem). *Isotoma stuxbergi* Tullberg, 1876; Moniez, 1891; Jacobson, 1898. *Isotomurus palustris* Börner, 1903. *Isotoma tricolor* Packard, 1873. *Isotoma aequalis* MacGillivray, 1902.

Description.—Length, to 3·0 mm. Thickly haired, but all hairs are simple except a few longer ones on segments V. and VI which are ciliated. Bothriotrichiae on abd. II.-IV. Colour very variable, from uniform yellowish-green to blackish, the lighter forms sometimes with longitudinal lines. Ocelli, 8 on each side. P.a.o. elliptical, as wide as two ocelli. Antennae half as long again as head. Claws long, without inner teeth. Empodial appendage lanceolate with lateral teeth and basally rounded inner lamella. Clavate tibiotarsal hairs absent. Dens twice as long as manubrium. Mucro with four teeth.

This cosmopolitan species is common everywhere on cultivated ground in the southern part of Western Australia, and also in South Australia Specimens have also been sent from Stanley, Tasmania, collected in 1930.

Var. Balteata (Reuter, 1876).

= *Isotoma balteata* Reuter, 1876; *Isotoma palustris* var. *balteata* Schött, 1893, Reuter, 1895.

This variety has the anterior three-fourths of the abdominal segments dorsally of a bluish colour. It occurred rather abundantly in the hot-house of Government Gardens, Perth, Western Australia, on February 11, 1932. I have also seen specimens collected by Mr. A. R. Brimblecombe in a glass-house at Brisbane, Queensland, May 16, 1932.

Isotomurus chiltoni (Carp., 1925). (Text fig. 4, *i.-m.*)

= *Isotoma chiltoni* Carp., 1925.

This species was described by Dr. Carpenter from a single, somewhat abraded specimen from New Zealand. Owing to the poor condition of the specimen the original description is lacking in many important details. I have received many

specimens from various parts of Australia which appear to be co-specific with Carpenter's species, and I am able to give a somewhat fuller description. Dr. Carpenter's surmise that the body hairs when present might be ciliated is confirmed. No mention was made in the original description of the postantennal organ, but in many of my specimens this was observed to be present although comparatively small and only seen with difficulty. Similarly, no sensory setae were observed originally on the New Zealand specimen, and they were therefore presumed to be absent. In most of my specimens these setae were distinctly present. The presence of the latter places the species in *Isotomurus* and not *Isotoma*.

Fig. 4.

a.	*Proisotomurus papillatus*, n. g., n. sp.	Tip of ant. III.
b.	" " " "	Anterior ocellus and postantennal organ.
c.	" " " "	Claw and tip of tibiotarsus.
d.	" " " "	Mucro and tip of dens.
e.	" " " "	Abdominal sensory hair.
f.	*Isotomurus palustris* (Müll.)	Claw and tip of tibiotarsus.
g.	" " "	Mucro and tip of dens.
h.	*Isotoma tridentifera* v. *edenticulata*, n. v.	Claw and tip of tibiotarsus.
i.	*Isotomurus chiltoni* (Carp.)	Antennae.
j.	" " "	Anterior ocelli and postantennal organ.
k.	" " "	Claw and tip of tibiotarsus.
l.	" " "	Mucro and tip of dens.
m.	" " "	Dorsal body hairs.
n.	*Isotomurus echnidus*, n. sp.	Antennae II. showing specialized setae of male.
o.	" " "	Specialized setae of ant. II, of male.
p.	" " "	Claws and empodial appendage of leg III.
q.	" " "	Claws and empodial appendage of leg I.
r.	" " "	Mucro.

Amended Description.—Size, to 3·0 mm. Colour, variable, from yellowish with dark purple marking to almost completely bluish. Antennae twice as long as head, ratio of segments approximately 15 : 20 : 20 : 30. Ocelli, 8 on each side on dark patches, inner hinder pair of ocelli smaller than the others. P.a.o. present, small, elliptical, half as long as an anterior ocellus. Claws with prominent dorsolateral teeth and two fine inner teeth (one, in Carpenter's specimen).

Empodial appendage elongate with narrow outer lamella and broader basal inner lamella with an acute spine at the angle. Mucro with small ventral tooth and prominent apical tooth, as well as two dorsal teeth. Clothing of comparatively long and numerous, strongly ciliated setae, which are longer and stouter on the anal segments and on the head. In addition, sensory setae are present on abdomen II.-IV.

Localities.—Crawley, Western Australia, June 3, 1931 (D. C. S.); National Park, Western Australia, September 3, 1931 (D. C. S.); Sherbrook, Victoria, April 19, 1931 (H. F. D. and H. G. A.); Pinjarra, Western Australia, September 29, 1931 (D. C. S.); Adelaide, South Australia, April 7, 1932 (D. C. S.); Gooseberry Hill, Western Australia, June 6, 1932 (G. E. N.); Armadale, Western Australia, June, 1932 (G. E. N.); Albany, Western Australia, July 7, 1932 (H. W.); Porongorups, Western Australia, September 30, 1932 (H. W.).

Isotomurus echidnus, n. sp. (Text fig. 4, *n-r.*)

Description.—Length, 3·2 mm. Colour, bluish with dark posterior edges to the segments and a slight dorsal streak. Antennae bluish, II.-IV. lighter except apex of IV. Legs and manubrium bluish. Ocelli, 8 on each side, equal. P.a.o. present, half an ocellus in diameter, elliptical. Antennae two and a half times as long as the head, ratio of segments = 15 : 20 : 20 : 30, clothed with numerous short ciliated hairs between which are similar but simple spines. Claws approximately three times as long as mucro, with three very fine distal teeth inside. Empodial appendage about one-half the length of claw, with fine outer distal tooth on leg III.; shorter and without tooth on leg I. Clavate tibiotarsal hairs absent. Furca strong, reaching ventral tube, ratio of manubrium to mucrodens = 35 : 42, mucro with only two teeth. Clothing of numerous very short, curved, ciliated setae; around the neck, on head and dorsally on segments with many long stout parallel-sided, rather blunt ciliated setae. On the middle of abdomen III. in good specimens is a beard-like cluster of curved ciliated setae of intermediate length. Sensory setae are present at least on abdomen II.-IV. Ratio of th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. = 25 : 15 : 10 : 20 : 20 : 35 : 10 : 5. The male sex is remarkable for the presence, on the apical inner side of segment II. of the antennae, of a cluster of short strong and, in certain aspects, apically broadened and ciliated setae or spines.

Localities.—Holotype female and one other from Trevallyn, Tasmania, August 17, 1929 (V. V. H.); allotype male from Bridgewater, South Australia, June 6, 1932 (D. C. S.); Glen Osmond, South Australia, May 14, 1933 (H. W.); in numbers in moss, Waterfall Gully, South Australia, September, 1933 (H. W.).

Key to the Australian Species of Isotomurus.

1. Mucro with four teeth. 2
   Mucro with only two teeth. Some of the body setae large, parallel-sided and ciliated. Male with specialized setae on antennae II. *I. echidnus*, n. sp.
2. Most of the body setae simple, only a few ciliated ones on anal segments. P.a.o. large. *I. palustris* (Müller).
   All body setae ciliated, the larger ones always pointed apically. P.a.o., small. *I. chiltoni* (Carp.).

Genus Proisotoma Börner, 1906.

Syn.—*Isotoma* Tullberg, 1871 (ad partem).

Proisotoma Börner, 1901 (ad partem) (as subgenus).

Subgenus Isotomina Börner, 1903.

PROISOTOMA (ISOTOMINA) THERMOPHILA (Axels., 1907). (Text fig. 5, *a.e.*)

Description.—Length, 1·0 mm. Of general *Isotoma* facies, but abdomen IV. longer than III. Colour, greyish. All setae simple, rather longer on anal segments. Antennae indistinctly longer than the head, IV. without olfactory setae. P.a.o. elliptical, notched medially on each side, equal in length to 2-3 ocelli. Ocelli, 8 on each side, equal. Tarsi without clavate hairs. Abdomen V. and VI. fused. Furca scarcely reaching middle of abdomen II. Mucro with two teeth.

Numerous specimens which can be referred to this European species have been collected from the following localities:—Crawley, Western Australia, June 3, 1931 (D. C. S.); Gooseberry Hill, Western Australia, June 6, 1932 (G. E. N.); Bridgetown, Western Australia, June 16, 1932 (H. G. A.); Reedbeds, South Australia, May 4, 1933 (H. W.).

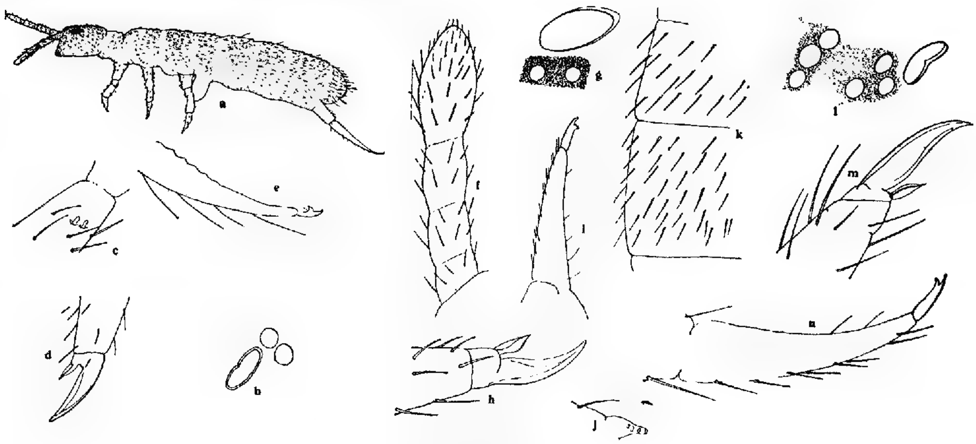

Fig. 5.

a.	*Proisotoma (Isotomina) thermophila* (Axels.)	Entire animal.
b.	" " " "	Anterior ocelli and postantennal organ.
c.	" " " "	Tip of ant. III.
d.	" " " "	Claw and empodial appendage.
e.	" " " "	Mucro and tip of dens.
f.	*Proisotoma ripicola* Linnan.	Antennae.
g.	" " "	Anterior ocelli and postantennal organ.
h.	" " "	Claw and tip of tibiotarsus.
i.	" " "	Mucro and dens.
j.	" " "	Rami of tenaculum.
k.	" " "	Dorsal body setae.
l.	*Proisotoma (Isotomina) sexoculata*, n. sp.	Ocelli and postantennal organ.
m.	" " " "	Claw and tip of tibiotarsus.
n.	" " " "	Mucro and dens.

Proisotoma (Isotomina) sexoculata, n. sp. (Text fig. 5, *l.-n.*)

Description.—Length, 1·0 mm. Colour, uniformly bluish. Antennae one-third longer than the head, ratio of segments = 10 : 15 : 15 : 25, antennal organ III. normal. P.a.o. two and a half times as long as an anterior ocellus. Ocelli, 6 on each side in two groups of three and on two patches of pigment which join, posterior group of ocelli unequal. Ratio of length of abdomen III. : IV. = 30 : 35, abdomen V. and VI fused. Claw with fine inner tooth. Tibiotarsus with two long indistinctively clavate hairs. Furca short and only just reaching abdomen II., ratio of manubrium : dens : mucro = 15 : 15 : 5; dens with 8 ventral and 2 subapical dorsal setae.

Localities.—Crawley, Western Australia, April, 1931 (D. C. S.); Sherbrook, Victoria, April, 1931 (H. F. D. & H. G. A.); ditto September, 1931 (H. F. D.); Sassafras, Victoria, December, 1931 (H. G. A.).

Syntypes in the South Australian Museum.

Remarks.—This species is closely related to *P. (I.) hirsuta* Denis from Costa Rica, but has a mucro very much smaller as compared with the dens.

Proisotoma (Isotomina) pilosa, n. sp. (Text fig. 6, *h.-j.*)

Description.—Length, 1·4 mm. Colour, bluish, darker on ocellar patches. Antennae barely longer than the head, ratio of segments = 1 : 1½ : 1½ : 2¼, IV. with terminal knob and ? one or two olfactory hairs, antennal organ III. as far as can be seen of normal structure. Ocelli, 6 on each side on a single patch of pigment. P.a.o. elliptical, equal to one anterior ocellus in diameter. Claws unarmed. Empodial appendage lanceolate. Clavate tibiotarsal hairs absent. Furca short, only reaching posterior edge of abdomen II. Mucrodens subequal to manubrium, mucro with two teeth, half the length of dens, dens with 3 ventral setae, the basal one longer than the others, and three short setae apically and dorsally, dentes not annulated. Manubrium ventrally with 7-8 setae. Rami with 4 barbs and basal seta. Abdomen III. : IV. = 4 : 4½, V. and VI. fused. Clothing of strong setae much as in *P. (I.) hirsuta* Denis; some longer on anal segments.

Locality.—In moss from Waterfall Gully, Mount Lofty Ranges, South Australia, May 6, 1933 (H. W.).

Syntypes in the South Australian Museum.

Remarks.—Like the preceding, this species is very close to *P. (I.) hirsuta* Den. from Costa Rica, but differs in the complete absence of clavate tibiotarsal hairs, the length of the p.a.o., the shape of the empodial appendage, the dental setae and the relative lengths of the mucro and dens.

Subgenus Proisotoma s. str. Börner, 1906.

Proisotoma ripicola Linnaniemi, 1912. (Text fig. 5, *f.-k.*)

= ? *Isotoma agilis* Schtscherbakow, 1899; Axelson, 1905. *Proisotoma agilis* (Axels.) Linnaniemi, 1907.

Description.—Length, to 1·2 mm. Colour, greyish to dark violet. Antennae slightly longer than head. Antennae IV. with terminal knob, without olfactory hairs. P.a.o. elliptical, as long as 2-3 ocelli. Ocelli, 8 on each side, equal. Clavate tibiotarsal hairs absent. Claws large, unarmed. Empodial appendage scarcely half as long as claw and with narrow angular inner lamella. Abdomen IV.-VI. distinctly separated. Rami with 4 barbs and corpus tenaculi with 2-3 setae. Furca reaching middle of abdomen II. Manubrium thickly haired dorsally, with 2 unusually long, strong distal setae ventrally. Dentes annulated, with numerous short setae. Mucro plump with 2 teeth, of which the apical is decidedly the shorter. Clothing of short and equally long hairs.

This European species has been received from Nangarra, Western Australia, November 21, 1930 (B. A. O'C.); Gooseberry Hill, Western Australia, June 2, 1932 (G. E. N.); St. Ronan's Well, Western Australia, June 11, 1932 (G. E. N.).

Proisotoma schötti (Dalla Torre, 1895). (Text fig. 6, *a-d.*)

= *Isotoma litoralis* Schött, 1893; *Isotoma schötti* Dalla Torre, 1895; *Isotoma lacustris* Schött, 1896.

Description.—Length, 2·0 mm. Colour, violet. Antennae only slightly longer than the head. Ocelli, 8 on each side. P.a.o. as long as a single ocellus. Empodial appendage with a very distinct apical bristle. Furca reaching ventral tube; dens without ventral setae, not tapering apically. Mucro with two teeth and distinct broad lamella. No clavate tibiotarsal hairs.

I have seen specimens of this common European species from the following localities:—Cannington, Western Australia, July 7, 1931 (H. W.); specimens in the South Australian Museum from Adelaide, without data; Perth, Western Australia, 1932 (H. W.); Woodside, South Australia, July, 1933 (H. W.).

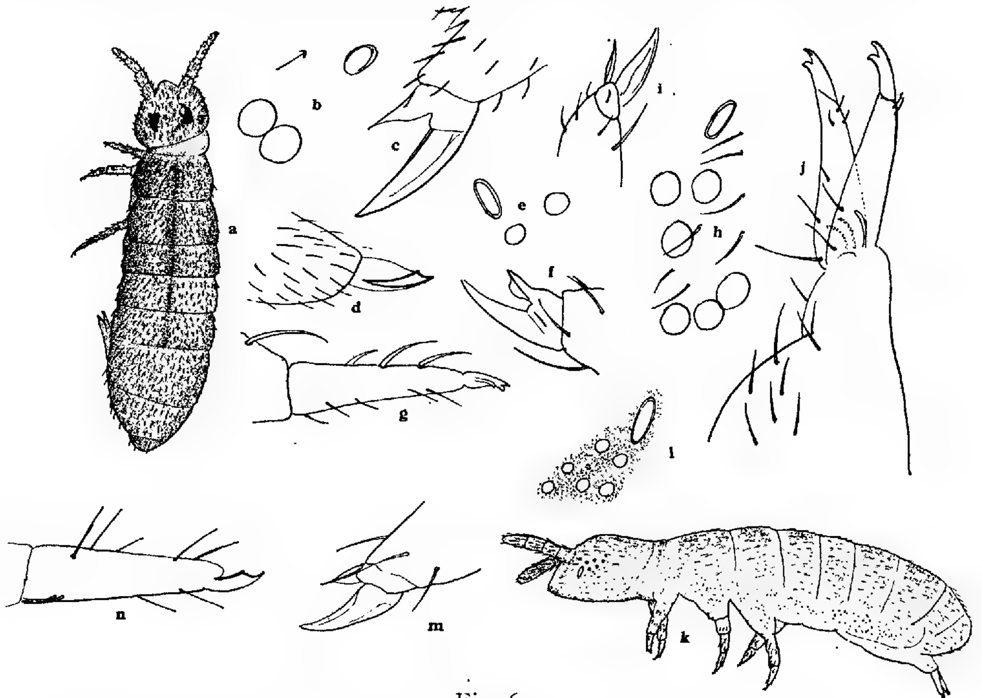

Fig. 6.

a.	*Proisotoma schötti* (Dalla Torre)	Entire animal.
b.	" " " "	Anterior ocelli and postantennal organ.
c.	" " " "	Claw and tip of tibiotarsus.
d.	" " " "	Mucro.
e.	" *minuta* (Tullbg.)	Anterior ocelli and postantennal organ.
f.	" " " "	Claw and empodial appendage.
g.	" " " "	Mucro and dens.
h.	" *(Isotomina) pilosa*, n. sp.	Ocelli and postantennal organ.
i.	" " " "	Claw and tip of tibiotarsus.
j.	" " " "	Furca.
k.	*Proisotoma sexophthalma*, n. sp.	Entire animal.
l.	" " "	Ocelli and postantennal organ.
m.	" " "	Claw and tip of tibiotarsus.
n.	" " "	Dens and mucro.

Var. **lutea**, n. var.

Specimens collected on the beach at Hallett's Cove, South Australia, in November, 1931 (D. C. S.), only differ from the typical form in the colouration, which is of a yellowish-green with a dark medial longitudinal streak.

PROISOTOMA MINUTA (Tullberg, 1871). (Text fig. 6, *c.-g.*)

= *Isotoma minuta* Tullberg, 1871; *Isotoma troglodytica* Rainbow, 1907.

Mucrones with 3 teeth. Tibiotarsus without clavate hairs or only with two weak ones (var. *clavipila* Axels.). Ocelli, 8 on each side. Antennae only slightly longer than the head. Colour, greyish.

This is a common species in Europe, occurring in and on soil in cultivated areas. It has been recorded from Australia by Dr. J. Davidson as occurring in large numbers in the soil of a tomato-house at Glenelg, South Australia, on June 27, 1929, and the writer found it commonly at Perth and Guildford in Western Australia, in 1931.

Through the courtesy of the authorities of the Australian Museum, Sydney, I have been able to re-examine the type slides of Rainbow's *Isotoma troglodytica,* described from Yarrangobilly Caves, New South Wales, in 1907. His specimens are identical with *P. minuta,* and therefore his name must be regarded as synonymous.

Proisotoma sexophthalma, n. sp. (Text fig. 6, *k.-n.*)

Description.—Length, to 0·7 mm. Colour, greyish with light specks. Antennae slightly shorter than the head, ratio of segments = 2 : 3 : 3 : 5. Ocelli small, 6 on each side and not on pigmented patches. P.a.o. elliptical, about 5 times the diameter of an ocellus, entire. Claws unarmed. Empodial appendage with narrow inner and broader outer lamellae. No clavate tibiotarsal hairs. Furca short and stout, not reaching beyond abdomen II.; dentes and mucrones as in fig. 9 *d.* Clothing sparse, of fairly short, simple setae, scarcely longer on apical segments.

Locality.—National Park, Western Australia, September 3, 1931 (D. C. S.).

Syntypes in the South Australian Museum.

Remarks.—This very distinct species is nearest to *P. micrura* Börner from South America, which differs in having a single distinctly clavate tibiotarsal hair, longer antennae and longer mucrones.

KEY TO THE AUSTRALIAN SPECIES OF PROISOTOMA.

1. Abdominal segments V. and VI. fused. Subgenus, *Isotomina* Börner. 2
   Abdominal segments all distinctly separated. Subgenus, *Proisotoma,* Börner. 4
2. Ocelli, 8 on each side on a single dark patch. Anteapical tooth of mucro about the middle. *P. (I.) thermophila* (Axels).
   Ocelli, 6 on each side. 3
3. Ocelli in two groups on different patches of pigment only lightly joined. Mucro one-third the length of dens. Dentes haired the whole length dorsally. P.a.o. as long as three ocelli. *P. (I.) sexoculata,* n. sp.
   Ocelli in two groups, but on a single patch of pigment. Mucro half the length of dens. Dentes dorsally with a few short setae at tip. P.a.o. the length of a single ocellus. *P. (I.) pilosa,* n. sp.
4. Ocelli, 8 on each side on black patches of pigment. 5
   Ocelli, 6 on each side, small, and not surrounded with pigment. P.a.o. equal to 5 ocelli, elliptical. Small plump species. *P. sexophthalma,* n. sp.
5. Mucro, plump, with 2 teeth and a very broad, distinct lamella. No clavate tibiotarsal hairs. Furca reaching ventral tube. P.a.o. equal to a single ocellus. *P. schotti* (D.T.).
   Mucro without distinct lamella. 6
6. Mucro with three teeth. No clavate tibiotarsal hairs or only two very weak ones (var. *clavipila* Axels.). *P. minuta* (Tullberg).
   Mucro with two teeth. Claws unarmed. P.a.o. elliptical, entire, equal to 2-3 ocelli. Clavate tibiotarsal hairs absent. *P. ripicola* Linnaniemi.

Genus ISOTOMA s. str. Börner, 1906.

ISOTOMA TRIDENTIFERA Schött, 1917.

Description.—Length, to 1·5 mm. Colour, light bluish-grey. Antennae twice as long as head. Ocelli, 8 on each side, the proximal ocelli smaller. Hairs of body short, depressed, slightly longer on end of abdomen, all simple. Claws with 2 inner teeth (absent in var. *edenticulata,* n. var.). Mucro small with two teeth.

This was the first and only true species of *Isotoma* to be previously recorded from Australia. It was originally found in North Queensland. I have had specimens collected by Miss J. W. Raff, from Beechworth, Victoria, in 1932; from New Town, Tasmania, collected by Mr. V. V. Hickman, in September, 1932; and have taken it myself around Adelaide, South Australia, in 1933.

Var. **edenticulata**, n. var. (Text fig. 4, *h.*)

The type specimen of this variety was found among debris on the shore of Government House Lake, Rottnest Island, Western Australia, in 1930 (L. J. G.). Other localities are Salt Lakes, Rottnest Island, Western Australia, January, 1931 (H. W.); Crawley, Western Australia, June, 1931 (D. C. S.); You Yang Mountains, Victoria, September, 1931 (J. W. R.); Pickering Brook, Western Australia, July, 1932 (G. E. N.); Albany, Western Australia, July, 1932 (H. W.).

Type in the South Australian Museum.

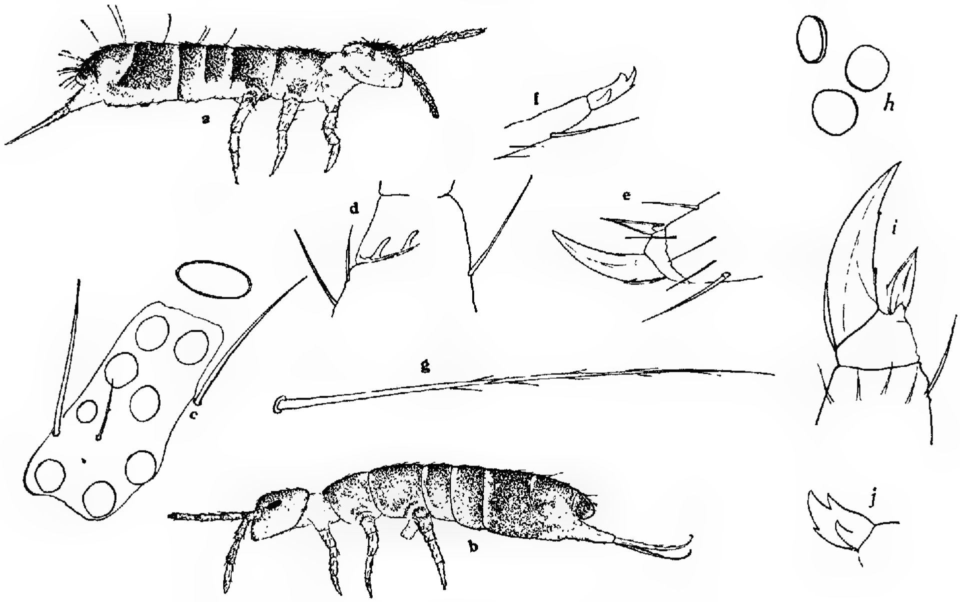

Fig. 7.

a.	*Isotoma swani*, n. sp.	Entire male animal.
b.	„ „ „	Entire female animal.
c.	„ „ „	Ocelli and p. a. o.
d.	„ „ „	Sensory organ on ant. III.
e.	„ „ „	Claw and tip of tibiotarsus.
f.	„ „ „	Mucro and tip of dens.
g.	„ „ „	Long dorsal seta of male.
h.	„ *georgiana* Schffr.	P. a. o. and anterior ocelli.
i.	„ „ „	Tip of tibiotarsus.
j.	„ „ „	Mucro.

Isotoma swani, n. sp. (Text fig. 7, *a-g.*)

Description.—Length, 1·4 mm. Colour, bluish-grey with whitish anterior margins to segments; whitish on venter, legs, furca and lower part of sides of head, prothorax and furcal segment. Antennae nearly one and three-quarter times the head length; ratio of segments = 15 : 20 : 20 : 32. Antennal organ III. as in figure 10 *d*. Ocelli, 8 on each side on dark patches, unequal. P.a.o. one and a half times the diameter of an anterior ocellus, broadly elliptical. Claws strong,

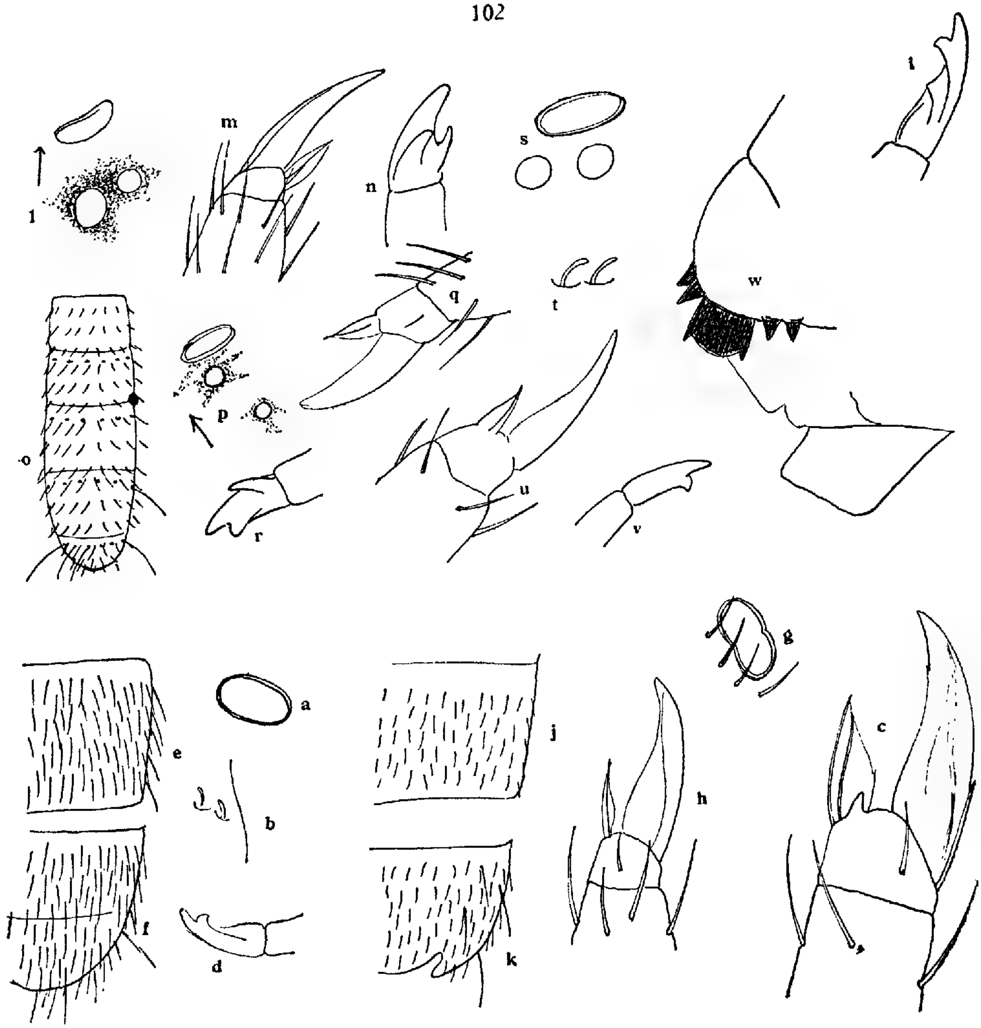

Fig. 8.

a.	*Isotoma termitophila*, n. sp.	Postantennal organ.
b.	" " "	Sensory organ of ant. III.
c.	" " "	Claw and empodial appendage.
d.	" " "	Mucro.
e.	" " "	Dorsal surface of abdom. IV.
f.	" " "	" " " " V. and VI.
g.	" *linnaniemia*, n. sp.	Postantennal organ.
h.	" " "	Claw and empodial appendage.
i.	" " "	Mucro.
j.	" " "	Dorsal surface of abdom. IV.
k.	" " "	" " " " V. and VI.
l.	*Isotoma bioculata*, n. sp.	Ocelli and postantennal organ.
m.	" " "	Claw and tip of tibiotarsus.
n.	" " "	Mucro.
o.	" " "	Dorsal view of abdom. segments.
p.	" *raffi* "	Ocelli and postantennal organ.
q.	" " "	Claw and tip of tibiotarsus.
r.	" " "	Mucro.
s.	*Spinisotoma dimorpha*, n. sp.	Anterior ocelli and postantennal organ.
t.	" " "	Sensory organ of ant. III.
u.	" " "	Claw and tip of tibiotarsus.
v.	" " "	Mucro.
w.	" " "	Chitinous teeth on abdom. V. of male.

with strong inner tooth at about one-third from base, and a strong outer lateral tooth. Empodial appendage with broad inner lamella, apically pointed. Clavate tibiotarsal hairs absent. Furca long, reaching ventral tube. Mucrodens twice as long as manubrium. Mucro with 4 teeth, apical very small and not reaching subapical. Clothing of moderately numerous short and fine setae. In the male on abdominal segment are some much longer and stronger curved setae which are longer than the width of segments and coarsely ciliated; these are absent in the female.

Locality.—Holotype and allotype from National Park, Western Australia, September, 1931 (D. C. S.).

Types in the South Australian Museum.

Isotoma termitophila, n. sp. (Text fig. 8, *a-f*.)

Description.—Length, to 2·5 mm. Colour, entirely white. Antennae half as long again as the head; ratio of segments = 10 : 22 : 20 : 48; antennae IV. with a terminal knob, antennal organ III. as in figure 11, *b.*, IV. without olfactory hairs. Ocelli entirely absent. P.a.o. fairly large, broadly elliptical, not medially notched. Claws strong with fine inner tooth at one-third from tip, and a prominent outer basal tooth. Empodial appendage with outer and broad inner lamellae, the inner lamella with a fine tooth at the angle. Furca almost reaching ventral tube, dentes nearly twice as long as manubrium; mucro small with three teeth, dentes with subapical bristle reaching tip of mucro and ventrally with long setae. Rami with 4 barbs. Clothing of moderately short setae but the abdominal segments have some longer equally fine but outstanding setae; all setae simple and not ciliated.

Localities. — Type from Parkerville, Western Australia, with termites, October, 1930 (H. W.); Armadale, Western Australia, July, 1931 (H. W. and D. C. S.); King's Park, Western Australia, August, 1931 (H. W.); Crawley, Western Australia, April, 1931 (D. C. S.).

Remarks.—In morphological details this species is very close to *Isotoma sphagneticola* Axelson, but differs in having an inner and outer tooth to the claw. It should not, however, be confused owing to its very different facies. It is of the somewhat heavier build of *Folsomia*, whereas *I. sphagneticola* is more graceful, recalling the form of the *I. notabilis* group.

Isotoma linnaniemia, n. sp. (Text fig. 8, *g.-k.*)

Description.—Length, 1·0 mm. Colour, entirely white. Facies as in *Isotoma sphagneticola* Linnan. Antennae only slightly longer than the head, ratio of segments = 6 : 12 : 12 : 16. Antennae IV. with small terminal knob but no olfactory hairs. Antennal organ III. normal. Ocelli absent. P.a.o. large, elliptical, doubly contoured and with distinct indication of division. Claws unarmed. Empodial appendage pointed, about half the length of claw with narrow outer and broad inner lamellae, inner lamella with tooth. Furca short, reaching only to posterior margin of abdomen II. Mucrodens twice as long an manubrium. Mucro with three teeth almost in a line. Clothing of numerous short, simple setae, with only a few slightly longer ones on abdomen V. and VI. Ratio of th. II. : III. : abd. I. : II. : III. : IV. : V. and VI. = 32 : 25 : 22 : 25 : 30 : 20; V. and VI. completely fused.

Localities.—Crawley, Western Australia, April, 1932 (D. C. S.); Preston Valley, Western Australia, June, 1931 (H. W.); Gooseberry Hill, Western Australia, June, 1932 (G. E. N.).

Type in the South Australian Museum.

Remarks.—This species, which resembles the European *I. sphagneticola* Linnan., is separated therefrom by the fewer longer setae on abdomen V. and VI.,

and on the trochanters. These setae are also quite simple and not ciliated. The p.a.o. of *I. sphagneticola* is quite entire without any medial notch, while the furca reaches the ventral tube. From *I. termitophila*, n. sp., it differs in the general facies, the form of the p.a.o., the dentition of the claw, the structure of the empodial appendage, and in the nature of the clothing.

Isotoma bi-oculata, n. sp. (Text fig. 8, *l.-o.*)

Description.—Length, 1·0 mm. Colour, white except for the eye patch which is bluish. Antennae half as long again as the head, ratio of segments = 6 : 12 : 13 : 20; antennal organ III. normal. Ocelli, two on each side, unequal, the anterior ocellus the smaller, both close together on a small blue patch of pigment. P.a.o. kidney-shaped, twice as long as the anterior ocellus. Claws long and strong with inner tooth. Empodial appendage less than half as long as claw, with inner and outer lamellae. Furca long, reaching ventral tube. Mucrodens about three times as long as manubrium; mucro with three teeth, two in line and one distinctly lateral. Ratio of th. II. : III. : abd. I. : II. : III. : IV. : V. and VI. = 35 : 25 : 14 : 16 : 20 : 21 : 15; V. and VI indistinctly separated. Clothing generally of fairly long, simple setae, but all segments have an anterior row of six or more very long curved setae which are longer than the width of the segments and ciliated on one side.

Localities.—Sherbrook, Victoria, September, 1931 (H. F. D.); Sassafras, Victoria, December, 1931 (H. G. A.).

Remarks.—This species differs abundantly from any described forms in the two ocelli on each side and in the characteristic long ciliated setae on the body segments.

Isotoma raffi, n. sp. (Text fig. 8, *p.-r.*)

Description.—Length, 0·7 mm. Colour, greyish-white except the two small dark pigmented eye-patches on each side. Antennae half as long again as the head, ratio of segments = 8 : 11 : 11 : 20, antennal organ III. normal. Ocelli, two on each side, each on a separate patch of pigment. The anterior ocellus is the larger. P.a.o. broadly oval, twice as long as the anterior ocellus and almost touching it. Claws unarmed. Empodial appendage half as long as claw and with inner and outer lamellae. Furca reaching ventral tube, mucrodens at least two and a half times as long as the manubrium, mucro as in preceding species except that the subapical tooth is distinctly distal. Clothing of numerous fine setae with a few longer and more outstanding ones on anal segments; these are not so long as in preceding species nor are they ciliated.

Syntypes from You Yang Mountains, Victoria, September 24 (Miss J. R.); in the South Australian Museum.

Remarks.—This species is very closely related to the preceding, but may be distinguished by the characters given in the key.

Isotoma notabilis Schäffer, 1896.

Description.—Length, 1·0 mm. Light greyish in colour. Body setae short, the longer ones slightly ciliated. Antennae half as long as the head. Ocelli, 4 on each side on a dark patch. P.a.o. broadly elliptical and as long as one ocellus. Claws unarmed. Empodial appendage pointed, without teeth, half the length of claw. Dens approximately three times as long as the manubrium. Mucro with 3-4 teeth, the proximal close together.

This well-known species has been found in a green-house at Adelaide, South Australia, in March, 1933 (H. M. H.).

Isotoma bipunctata Axelson, 1903.

Description.—Length, to 0·8 mm. Colour, white. Body setae short and simple. Antennae slightly longer than the head. Antennae IV. with a small olfactory hair and terminal papilla. Ocelli, 1 on each side on a small pigmented patch. P.a.o. elliptical, as broad as 4 ocelli. Claws unarmed. Furca reaching middle of abdomen II. Manubrium as long as mucrodens. Mucro with 2-3 teeth.

This European species was taken along with the preceding, in a greenhouse at Adelaide, South Australia, in March, 1933 (H. M. H.).

Isotoma olivacea Tullberg, 1871.

Description.—Length, to 2·0 mm. Colour, olive-green with a lighter ground colour, sometimes bluish. Head and body with light flecks, extremities lighter. Clothing of short thick setae. Antennae half as long again as the head. Antennae IV. without olfactory hairs, with terminal knob. P.a.o. elliptical, as wide as one and a half to three ocelli. Claws with broad base, outer tooth and small inner tooth. Empodial appendage half the length of claw, with tooth at inner angle. Ratio of dens to manubrium = 44 : 19; dens dorsally annulated. Mucro with 4 teeth, apical the strongest and curved, proximal teeth equal.

This is another common European species. It was found in numbers in the laboratory at the Waite Institute, Adelaide, South Australia, in October, 1933, by Mr. J. W. Evans. The specimens had undoubtedly come from herbage growing outside.

Isotoma georgiana Schäffer, 1891. (Text fig. 7, *h.-j.*)

Description.—Length, to 2·0 mm. (Schäffer, 3·0 mm.). Colour, dark bluish-black, uniform. Antennae rather longer than head, ratio of segments = 7 : 9 : 9 : 13. Ocelli, 8 on each side on dark patches. Postantennal organ small, about as long as an ocellus, subelliptical (not observed by Schäffer). Furca long, reaching ventral tube, mucrodens about three times as long as manubrium, dens with numerous strong setae, mucro with four teeth, the apical one small and short, the basal teeth not opposite. Claws strong with fine proximal and distal teeth. Empodial appendage pointed with inner and outer lamellae and tooth at the inner angle. Body clothing of numerous setae, most of which are strong but short, though many are much longer.

Locality.—Two specimens of this species were taken in moss in the Coorong, South Australia, on May 17, 1934 (R. V. S.).

Remarks.—Except in the postantennal organ and the shorter antennae, particularly the fourth segment which is much shorter than the head, there are no differences in my specimens from Schäffer's description. Hitherto this species has been known only from the Subantarctic, but that it should reach the coastal regions of Southern Australia is not surprising. The writer knows of several other subantarctic species which occur in New Zealand and which will be recorded in due course.

Key to the Australian Species of Isotoma.

1. Ocelli, 8 on each side. 2
   Ocelli, fewer than 8 on each side. 4
2. Mucro with 4 teeth. 3
   Mucro with 3 teeth. Colour, light bluish-grey. Claw with 2 inner teeth or without (var. *denticulata* n. var.). *I. tridentifera* Schött.
3. Apical tooth of mucro long and slender, the proximal teeth on a level or nearly so. Not sexually dimorphic. P.a.o. equal to 1½-3 ocelli. *I. olivacea* Tullberg.

Apical tooth of mucro short, proximal teeth not level. Sexually dimorphic species, male with long ciliated setae on distal abdominal segments. P.a.o. equal to two ocelli. Claw without distal inner tooth. *I swani*, n. sp.

Apical tooth of mucro short, proximal teeth not opposite. Not sexually dimorphic. All setae strong and simple. P.a.o. equal to one ocellus. Claw with distal inner tooth. *I. georgiana* Schäffer.

4. Ocelli entirely absent. 8
Ocelli, 1, 2, or 4 on each side. 5

5. Ocelli, 1 on each side on a small patch of pigment. P.a.o. elliptical, equal to 4 ocelli. Colour, white. Mucro with 2-3 teeth. *I. bipunctata* Axelson.

Ocelli, 2 or 4 on each side. 6

6. Ocelli, 2 on each side. 7
Ocelli, 4 on each side on a dark patch. Colour, light bluish-grey. P.a.o. broadly elliptical, as long as the patch of pigment. Mucro with 3-4 teeth. *I. notabilis* Schäffer.

7. Both ocelli on same patch of pigment, anterior ocellus the smaller. P.a.o. kidney shaped, widely separated from anterior ocellus. Abdominal segments with a subposterior row of long, strongly ciliated setae. *I. bioculata*, n. sp.

Each ocellus on a separate patch of pigment, separated by at least two ocellar diameters. Anterior ocellus the larger, almost touching the p.a.o., this broadly oval, about twice as long as the anterior ocellus. No long ciliated setae on abdominal segments. *I. raffi*, n. sp.

8. Large, stout species of *Folsomia* facies. White. P.a.o. broadly elliptical, margins entire. Claws with inner and prominent basal teeth. Mucro with three teeth. Body segments with fairly long, fine setae, longer but simple on anal segments. Termitophilous. *I. termitophila*, n. sp.

Smaller species of *I. sphagelicola* facies. White. P.a.o. broadly elliptical, more clongate, lateral edges notched. Claws unarmed. Mucro tridentate. Body setae shorter and with fewer longer ones. *I. linnaniemi*, n. sp.

Spinisotoma Stach, 1926.

This very interesting genus was erected in 1926 for an Isotoma found in South-west Poland. It differs from related genera of the Isotominae in having a series of spines on the fifth abdominal segment. Anal spines of some form are known to occur in several genera of this subfamily, notably those placed by Börner in his tribe Anurophorini, as *Uzelia*, *Tetracanthella* and *Proctostephanus*. Stach's genus, however, is of typical *Isotoma* facies, and the terminal position of the anus definitely places it in the tribe Isotomini.

The genus is characterised thus:—Body elongate of *Isotoma* facies, all abdominal segments separated, antennae IV. without sensory knob at apex, ocelli 8 on each side, anus terminal, abdomen V. with anal horns or spines in both sexes or only in male, claw without tunica, no clavate tibiotarsal hairs, furca present and long and annulated, mucro of *Isotoma* type.

Spinisotoma dimorpha, n. sp. (Text fig. 8, *s.-w.*)

Description.—Length, 0·8 mm. Colour, ? (the two specimens have been mounted for some time and have lost any pigment originally present). Antennae one-third longer than head, ratio of segments = 8 : 10 : 10 : 19, antennae IV. without terminal knob, III. with sensory organ as in figure 12, *i*. Ocelli, 8 on each side on dark patches. P.a.o. about twice an ocellus in diameter. Claws unarmed. Empodial appendage with narrow inner and broader outer lamellae. Furca long but only reaching anterior margin of abdomen II. Mucrodens twice as long as manubrium, mucro small with two teeth. Relative lengths of body segments = th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. = 25 : 30 : 18 : 20 : 20 : 20 : 10 : 5. Abdomen V. posteriorly in male with 6 strong and

stout heavily chitinised yellow spines or teeth arising directly from the cuticle; the two outer spines on each side are triangular and only slightly longer than broad at their base; the two inner ones are rather longer and joined together just below their apices to form a saddle piece. Clothing of numerous short and fine setae, none of which are much longer towards the apex.

Locality.—One male and one female in grass sweepings at Urrbrae, South Australia, in October, 1929 (D. C. S.).

Types in the South Australian Museum.

Remarks.—The structure of the spines in this species differs from those of the genotype *Spinisotoma pectinata* Stach, in that they arise direct from the cuticle or surface of the segment. In Stach's species they are only four in number and placed on distinct and prominent papillae. The crown of thorns (about 30) on the same segment in *Proctostephanus stuckeri* Börner appears to be of a similar nature to those in our species, but *Proctostephanus* is placed by Börner in the tribe Anurophorini.

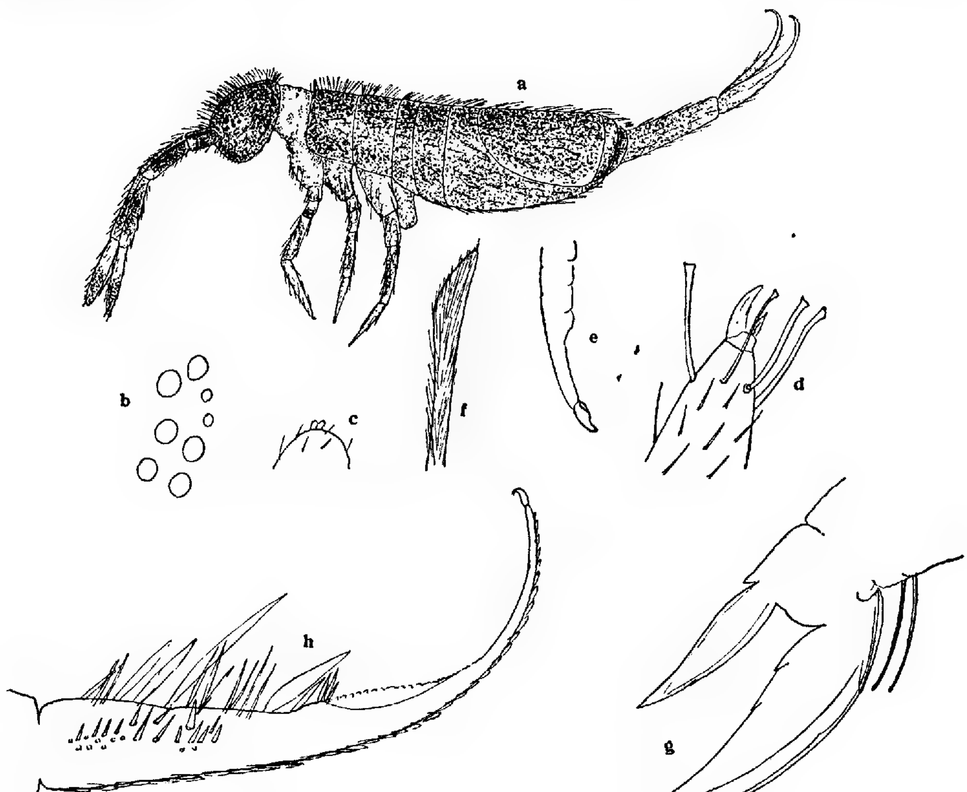

Fig. 9.

a.	*Isotobrya wheeleri*, n. g., n. sp.	Entire animal.
b.	„ „ „ „	Ocelli.
c.	„ „ „ „	Tip of ant. IV.
d.	„ „ „ „	Tip of tibiotarsus.
e.	„ „ „ „	Mucro and tip of dens.
f.	„ „ „ „	Ciliated thoracic hair.
g.	*Lepidophorella australis* Carp.	Claw, empodial appendage, and tip of tibiotarsus.
h.	„ „ „	Dens and mucro.

Genus **Isotobrya**, gen. nov.

Description.—General facies of *Entomobrya* type. Abdomen IV. several times longer than III. Antennae long, 4-segmented, IV. with double terminal knob. Clavate tibiotarsal hairs present. Claws simple, of *Isotoma* type. Furca long, dentes faintly annulated, mucro falciform. Clothing of numerous long ciliated setae which are clavate on the head and thorax. Abdominal segments apparently without sensory setae. Empodial appendage present. Scales absent.

Remarks.—This genus is extremely interesting in that it connects in many characters the subfamilies Isotominae and Entomobryinae. In its general form and clavate ciliated thoracic setae it agrees with the latter; in its simple claws with the former.

Genotype.—*Isotobrya wheeleri,* n. sp.

Isotobrya wheeleri, n. sp. (Text fig. 9, *a.-f.*)

Description.—Length, 2·0 mm. Colour, blackish, except on legs, furca, prothorax and base of antennae IV., which are white. Antennae nearly three times as long as head, ratio of segments = 6 : 10 : 7 : 10. Ocelli, 8 on each side, unequal, not on a dark patch. P.a.o. absent. Legs long, tibiotarsus with 4 clavate tibiotarsal hairs; claws with faint inner tooth about the middle. Empodial appendage simple, lanceolate and half as long as claw. Furca reaching ventral tube, ratio of manubrium to mucrodens = 20 : 20, mucro falciform with small basal lamellae, but without basal spine. Clothing of numerous long ciliated setae, many on the head and thorax clavate. Abdominal sensory setae absent. Termitophilous.

Four specimens of this interesting species were found under a stone with termites at Mullewa, Western Australia, on September 9, 1931. As the writer was with that delightful companion and entomologist, Professor W. M. Wheeler, of Harvard, when the specimens were taken, it is with very pleasant memories that his name is associated with the species.

Syntypes in the South Australian Museum.

Family TOMOCERIDAE (Schäffer, 1896).

Subfamily LEPIDOPHORELLINAE (Börner, 1897).

Genus Lepidophorella Schäffer, 1897.

Syn. = *Drepanura* Moniez, 1894; nec. Schött, 1891.

Lepidophorella australis Carpenter, 1925. (Text fig. 9, *g.-h.*)

Description.—Length, 3-4 mm. Colour, pale straw-yellow with basal rings on the second antennal segment, and the whole of the fourth segment dark purple; also with dark patches dorsally on thorax II. and abdomen I., II., IV. and V. Antennae three-fourths as long again as head, ratio of segments = 8 : 18 : 18 : 24. Ocelli, 8 on each side on dark fields. P.a.o. absent. Thorax II. two and a quarter times as long as III. Abdomen III. a third as long again as IV. Claws with strong dorsolateral and two prominent inner teeth. Empodial appendage lanceolate. Dentes one-third as long again as the manubrium, mucro falciform with upturned apex. Tibiotarsi with clavate hairs. Body covered with ribbed scales.

Locality.—Sherbrook, Victoria, April, 1931 (H. F. D. & H. G. A.).

Remarks.—This species, not previously recorded from Australia, was originally described from Campbell Island, New Zealand, by Dr. Carpenter in 1925. The above brief characters are taken from his description, but the figures are from Australian specimens. From the following species, *L. brachycephala*

(Moniez), which also occurs in both countries, it differs in having only two inner teeth to the claw and in the presence of the clavate tibiotarsal hairs.

LEPIDOPHORELLA BRACHYCEPHALA (Moniez).

= *Drepanura brachycephala* Moniez.

Localities.—Launceston, Tasmania, August, 1929 (V. V. H.); Cascades, Tasmania, August, 1932 (V. V. H.); Mount Nelson, Tasmania, September, 1932 (V. V. H.).

Family ENTOMOBRYIDEA Börner, 1913.

Subfamily ENTOMOBRYINAE Börner, 1906.

Tribe ENTOMOBRYINI Börner, 1906.

Genus SINELLA Brook, 1882.

SINELLA COECA (Schött), 1896; (Text fig. 10, *a.-b.*)

= *Entomobrya coeca* Schött, 1896; *Sinella hofti* Schäffer, 1896; *Sinella tenebricosa* Folsom, 1902.

Description. Length, to 2·0 mm. Entirely white and without ocelli. Hairs thick and close-lying, ciliated. Clavate tibiotarsal hairs absent. Claw with two large wing-like teeth basally on inside, and a strong inner tooth. Empodial appendage with outer wing-like tooth. Mucro falciform with strong basal spine.

This is a well-known European species which is found under stones in the open and under boards and plant-pots in green-houses. I have seen specimens from the following Australian localities:—Perth, Western Australia, in September and October, 1930 (H. W.); Bridgetown, Western Australia, December, 1930 (H. W.); Denmark, Western Australia, September, 1932 (H. W.); Brisbane, Queensland, October, 1932 (R. J. M. B.); Adelaide, South Australia, 1933 (H. W.).

SINELLA TERMITUM Schött, 1917. (Text fig. 10, *c.*)

= *Entomobrya cuniculicola* Pritchard, 1932.

Description.—Length, 1·0 mm. Colour, white with some small red pigment spots occasionally on head and thorax. Occasionally pigmented eye-spots are present. Antennae twice as long as head, IV. without terminal knob but with thick outstanding bristles. Thorax II. distinctly longer than III. Abdomen IV. three to four times as long as III. Claw with small lateral tooth and two unequal inner wing-teeth. Empodial appendage with large outer wing-tooth. Mucro with two teeth and basal spine. Body hairs strongly ciliated, clavate on head and thorax.

This common species was, except for the mucro, well figured by Schött. It is easily separated from the only other blind species by the bidentate mucro. It was recorded by Schött from North and South Queensland, but is widely distributed in all the southern portion of Australia, occurring with various species of ants and termites.

Localities.—Armadale, Western Australia, July, 1930 (D. C. S.); Beverley, Western Australia, October, 1930 (H. W.); Mundaring, Western Australia, February, 1930 (H. W.); Mount Lofty Ranges, South Australia, March, 1931 (D. C. S.); Sherbrook, Victoria, April, 1931 (H. G. A. and H. F. D.); Mandurah, Western Australia, April, 1931 (H. W.); Glen Osmond, South Australia, 1933 (H. W.); Reedbeds, South Australia, April, 1933 (H. W.); Victor Harbour, South Australia, January, 1934 (H. W.); Adelaide, South Australia, March, 1934, along with *Coptotermes*, sp. (H. W.).

Genus Entomobrya Rondani, 1861.

Syn. = *Podura* Linne, 1740 (ad partem); *Chorutes* Burmeister, 1838 (ad partem); *Isotoma* Bourlet, 1839 (ad partem); *Degeeria* Nicolet, 1841 (ad partem).

In this genus few characters of morphological importance are available for specific purposes, and one is therefore almost wholly forced to rely on colour and markings.

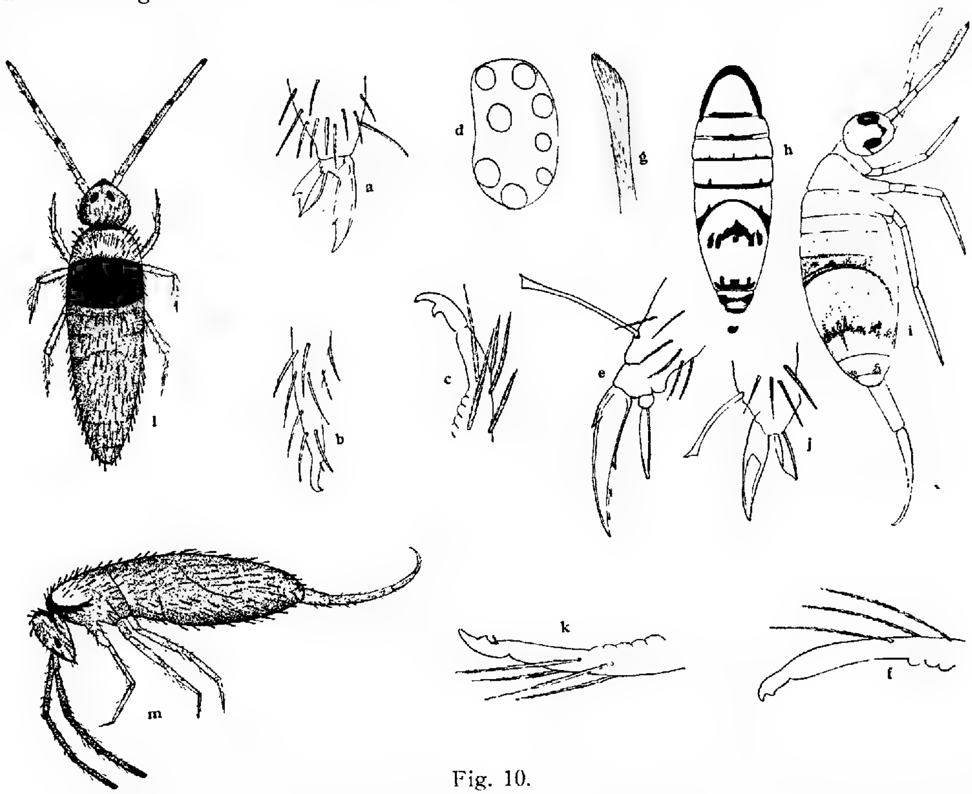

Fig. 10.

a. *Sinella cocca* Schött.	Claw, empodial appendage and tip of tibiotarsus.
b. „ „ „	Mucro and tip of dens.
c. „ *termitum* „	Mucro and tip of dens.
d. *Entomobrya clitellaria* Guth.	Ocelli.
e. „ „ „	Claw, empodial appendage and tip of tibiotarsus.
f. „ „ „	Mucro and tip of dens.
g. „ „ „	Ciliated thoracic hair.
h. „ *multifasciata* Tllbg.	Dorsal markings.
i. *Entomobrya maritima*, n. sp.	Entire animal.
j. „ „ „	Claw, empodial appendage and tip of tibiotarsus.
k. „ „ „	Mucro and tip of dens.
l. *Entomobrya clitellaria* Guth.	Typical form, dorsal view.
m. „ „ *v. newmani*, n. v.	Lateral view.

Entomobrya clittelaria Guthrie, 1902. (Text fig. 10, *d.-g.; l.-m.*)

This species was originally described by Guthrie from Minnesota, U.S.A., and has not hitherto been found outside of America. In Western and South Australia it is widely distributed. The typical form described by Guthrie has the

black band extending to the posterior margin of the third thoracic segment, whereas in the common form in Australia this band ends sharply at the anterior margin of the second abdominal segment. The ground colour is golden yellow, except on the mesothorax where it is white medially. There is a black neck-band and the tips of antennae II., III. and IV. are black. This, the common Australian form, does not differ sufficiently from the American to warrant a varietal name, but there occurs another form in which the black band on the body is entirely wanting. To this form I give the name of *E. clittelaria* var. **newmani,** after Mr. L. J. Newman, Government Entomologist of Western Australia. In addition to both forms being widely occurring in Western and South Australia, I have also received specimens from Studley Park, Victoria, August, 1931 (H. G. A.).

ENTOMOBRYA MULTIFASCIATA (Tullberg, 1871). (Text fig. 10, *h.*)

= *Degeeria multifasciata* Tullberg, 1871; *Entomobrya decemfasciata* (Packard, 1873), Handschin, 1929.

In this species there is a narrow black band on the front of the mesonotum, another on the posterior edge, and also on the posterior edge of the metathorax and all abdominal segments. There is also an irregular band in the middle of abdomen IV. In these markings there is considerable variation and on the strength of the bands not being broken in the middle in some specimens, Handschin (134) resurrected Packard's species *decemfasciata.* In correspondence, Dr. Folsom and Prof. Mills, in America, have criticised this action on the ground that it is impossible now to know what species Packard had before him. The differences in the markings are so small that I am inclined to agree, and herewith place all my material under Tullberg's name, although all specimens seen from Australia (as well as those which I have recently recorded from South Africa) agree with Handschin's data for Packard's form.

This species is almost cosmopolitan in its distribution, and in Australia is to be found in most cultivated places in the southern and western States.

ENTOMOBRYA MARGINATA (Tullberg, 1871).

= *Degeeria marginata* Tullberg, 1871; ? *Entomobrya multifasciata* Brook, 1883; *Entomobrya coerulea* Becker, 1902.

This species was recorded in its typical form from North Queensland by Schött in 1917. It is of a uniform lighter or darker violet colour with the posterior edges of the segments having a fine darker edging. In his paper Schött also described a new variety, *laticlavia,* in which the junctions of the tergites are without pigment and the free edges of thorax II. and III. have a broad dark border.

The typical form is plentiful in cultivated places in both Western and South Australia.

The pale variety, *pallida* Krausbauer, 1902, has not previously been recorded from Australia, although it is known from the Bismarck Archipelago. I have taken it at Muresk, October, 1930, and Mullewa, September, 1931, both in Western Australia.

ENTOMOBRYA TERMITOPHILA Schött, 1917.

A single specimen of this striking form was taken from moss from Mount Gambier, South Australia, in May, 1934 (R. V. S.).

ENTOMOTRYA VIRGATA Schött var. **nigrella** var. nov.

This variety differs from the typical form only in that the pigment is continuous between the bands on metanotum and third abdominal segment. A single

specimen was collected from moss from Waterfall Gully, South Australia, in May, 1934 (R. V. S.).

Type in the South Australian Museum.

Entomobrya tenuicauda Schött, 1917.

This species was described by Schött from the Mjöberg material collected in South Queensland. It was very well figured in his paper. I have taken specimens at Muresk, Western Australia, in October, 1939, and have also received specimens found in garden rubbish at New Town, Tasmania, in September, 1932, collected by Mr. V. V. Hickman.

Entomobrya lamingtonensis Schött, 1917.

This is an entirely blue species, except for the depigmented flecks and streaks on the anterior part of abdomen IV. It was originally described from the Mjöberg material collected in South Queensland. It is very closely related to *E. ambigua* Schött from North Queensland, which differs only in that the ante-apical tooth of the mucro is reduced. My records for this species are as follows:—Perth, Western Australia, November 18, 1930 (H. W.); Nangara, Western Australia, November 21, 1930 (B. A. O'C.); Mundaring, Western Australia, February, 1931 (H. W.); Crawley, Western Australia, 1931 (H. W.); You Yang Mountains, Victoria, September 24, 1931 (J. R.); Adelaide, South Australia, May, 1933 (H. W.); in moss, Waterfall Gully, South Australia, May 6, 1933 (H. W.).

Entomobrya varia Schött, 1917.

Specimens referable to this well described and figured species were collected in large numbers by sweeping the low herbage in King's Park, Perth, Western Australia, on September 5, 1931. It also occurred in large numbers under the loose bark of Karri trees at Denmark, Western Australia, and was found commonly in a similar habitat but on Eucalypts at Morialta, South Australia.

Entomobrya maritima, n. sp. (Text fig. 10, *i.-k.*)

Description.—Length, to 2·0 mm. Colour, yellowish with a dark spot between the antennae connected by a black line to the black ocellar patches. Third abdominal segment with posterior edge black, then a lighter line followed by a dark irregular band; abdomen IV. with an irregular dark cross band placed rather beyond the middle. Posteriorly on abdomen IV. is a pair of lateral black spots. Antennae three times as long as head, ratio of segments $= 2\frac{1}{2} : 6 : 6 : 7$. Ocelli, 8 on each side, equal. Mesothorax nearly twice as long as metathorax. Claws as in the genus but entirely without inner or lateral teeth. Empodial appendage apically with inner lamella. Tibiotarsus with strong, apically spathulate spur hair. Mucro bidentate with basal spine, unannulated portion of dens three times as long as mucro. Abdomen IV. in medial line about five times as long as III. Clothing of the usual ciliated hairs, clavate on thorax and head.

Locality.—Beneath and on the surface of stones between tide marks at Christie's Beach, South Australia, January 17, 1932 (D. C. S.).

Syntypes in the South Australian Museum.

Entomobrya nivalis Linne, 1758, f. immaculata Schäffer, 1896.

= *Entomobrya nivalis-pallida* Carl, 1901; *Degeeria lanuginosa* Nicolet, 1841; *Entomobrya multifasciata-lanuginosa* Brook, 1884; *E. flava* Lie-Pettersen, 1896.

This is a well-known European species of which the form *immaculata* Schäffer occurs commonly around Adelaide, South Australia, on cultivated land.

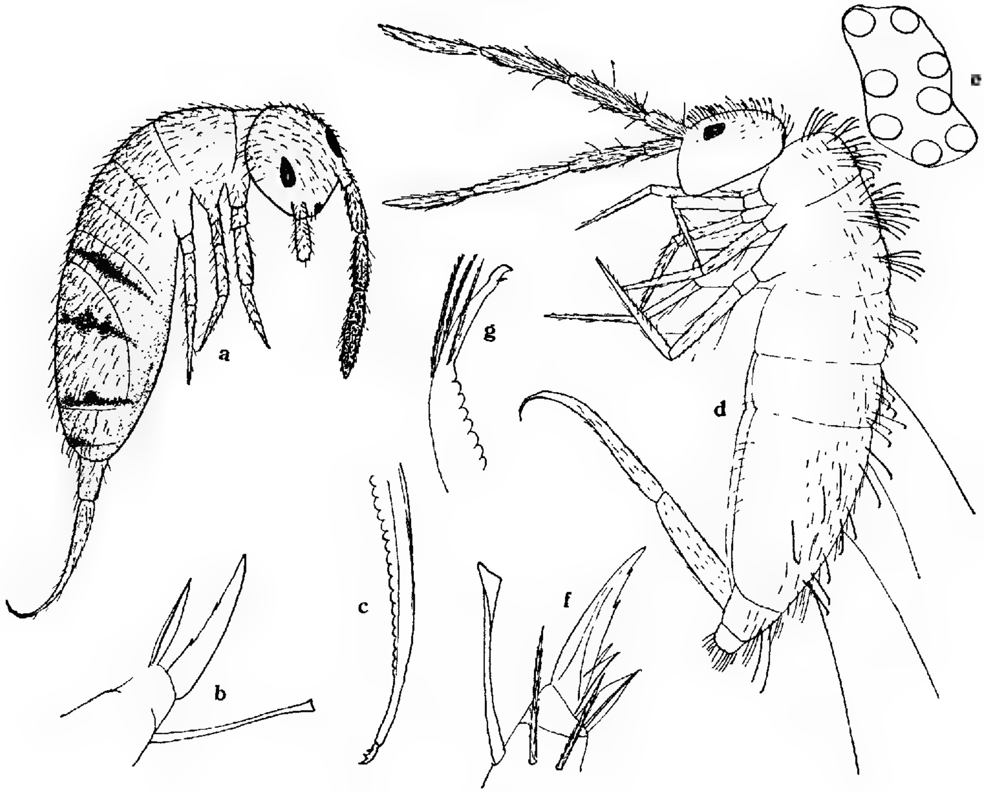

Fig. 11.

a. *Entomobrya mitchelli*, n. sp. Entire animal.
b. „ „ „ Claw, empodial appendage, and tip of tibiotarsus.
c. „ „ „ Mucro and tip of dens.
d. *Drepanura citricola*, n. sp. Entire animal.
e. „ „ „ Ocelli.
f. „ „ „ Claw, empodial appendage, and tip of tibiotarsus.
g. „ „ „ Mucro and tip of dens.

Entomobrya mitchelli, n. sp. (Text fig. 11, *a.-c.*)

Description.—Length, 1·2 mm. Colour, light yellowish-green with a blue cross-patch on abdomen III. and two on IV.; ocellar patches blue-black. Ocelli, 8 on each side. Antennae twice, or nearly so, as long as the head; ratio of segments = 3 : 6 : 6 : 9. Mesothorax one and three-fifth times as long as metathorax. Claws narrow, with two indistinct inner teeth and a lateral tooth. Empodial appendage lanceolate, reaching well beyond the distal inner tooth of claw. Furca long and thin, annulated. Mucro bidentate with basal spine. Unannulated portion of dens 3-4 times as long as mucro. Clothing normal.

This species was originally obtained by sweeping the low herbage in King's Park, Perth, Western Australia, in September, 1931 (H. W.), and later at Mount Barker, Western Australia, in September, 1932 (H. W.). It is named after Sir James Mitchell, then Premier of Western Australia.

Syntypes in the South Australian Museum.

Entomobrya tasmanica, n. sp. (Text fig. 12, *a.-c.*)

Description.—Length, 1·4 mm. Colour, light but with heavy broad blue bands on all segments and occupying the whole of the meso- and metathoracic segments and quite the posterior halves of the other segments. Antennae rather less pigmented, blue on the whole of III. and IV. and apically on I. and II. Antennae about twice as long as head. Ocelli, 8 on each side, the proximal pair very small and inconspicuous. Claws typical of the genus without lateral tooth, with a proximal pair of large and prominent teeth at about the middle of the inner edge, then a very distinct inner tooth followed by a finer more distal tooth. Empodial appendage not reaching the proximal teeth of claw, truncate apically. Furca long and reaching abdomen I., mucro bidentate with basal spine, annulated portion of dens five times as long as mucro and with three long ciliated setae. Mesothorax slightly longer than metathorax. Abdomen IV. five times as long as III. Clothing normal.

Locality.—Two specimens collected in the Domain, Hobart, Tasmania, in October, 1932, by Mr. V. V. Hickman.

Syntypes in the South Australian Museum.

Key to the Australian Species of Entomobrya.

1. Insects of a uniform colour. 8
   Insects marked with cross-bands or irregular markings. 2
2. Markings consisting of irregular spots, more or less forming longitudinal streaks. *E. varia* Schött.
   Markings in the form of broad bands occupying most of the posterior portions of the segments. *E. tasmanica,* n. sp.
   With narrow bands or banded on certain segments only. 3
3. With only a single cross-band on thorax or abdomen. 4
   With many cross-bands. 5
4. Black band on thorax III., abdomen I. and II. (or absent = var. *newmani* n. var.). Golden yellow species with thorax II. dorsally white. *E. clitellaria* Guthrie.
   Black cross-bands on abdomen III. and anterior part of IV. Yellowish-white species. Termitophilous. *E. termitophila* Schött.
5. Species with 3 to 4 broad cross-bands. 6
   Species with more, 8 to 10 narrower bands. 7
6. White species with broad cross-bands on thorax III., abdomen III. and posterior edge of IV., or this area all pigmented; also with a thin dark line on II. on the posterior border. Posterior edges of abdomen V., and all of VI., darkish. *E. virgata* Schött.
   Yellowish species with dark irregular bands of pigment on abdomen III., and just beyond middle of abdomen IV., and laterally on V. Empodial appendage truncate apically and broad. *E. maritima,* n. sp.
7. Three bands of dark pigment, one across middle of abdomen III., one just about middle or before of IV., and another posteriorly on IV. Empodial appendage normal. *E. mitchelli,* n. sp.
7. Dorsal bands broad, on abdomen II. extending the whole length of segment. Anteapical tooth of mucro reduced. *E. tenuicauda* Schött.
   Dorsal bands much narrower, largely confined to posterior margins of segments, interrupted or not in the middle. *E. multifasciata* (Tullberg)
8. Colour entirely yellowish-green, except for the ocellar patches and a spot between the antennae. *E. nivalis* Linne; f. *immaculata* Schäffer.
   Colour otherwise. 9
9. Anteapical tooth of mucro reduced, almost a falciform mucro. Colour entirely blue. *E. ambigua* Schött.
   Anteapical tooth of mucro normal. 10

10. Deep blue with depigmented flecks and streaks on abdomen IV. Mucro with two well developed teeth and basal spine. *E. lamingtonensis* Schött.

Pigment of a light violet or cobalt blue, with darker hind edges to segments. 11

11. Darker hind edges of segments present. *E. marginata* (Tullberg) ; var. *pallida* Krausbauer.

12. Pigmentation violet and uniform, except for the darker posterior margins of segments. *E. marginata* (Tullberg) *f. p.*

Pigmentation of a light cobalt blue. Intermediate portions of tergites without pigment. Hind margins of segments with a broader, darker band. Apical tergite and between antennae bases black. *E. marginata* (Tullberg) ; var. *laticlavia* Schött.

Genus Drepanura Schött, 1891 (nec. Moniez, 1894).

This genus, erected by Schött in 1891 (223) for *Drepanura californica*, differs from the preceding in having a falciform instead of a bidentate mucro. Since then it appears to have been ignored by other workers, and even in his own paper (226) Schött does not use it and places three species with falciform mucro in the genus *Entomobrya*. Recent workers on other groups of genera such as those previously included in the old genus *Lepidocyrtus* of Bourlet have made use of this difference in the form of the mucro to divide them up; it would therefore seem perfectly justifiable to resurrect the genus *Drepanura* with *D. californica* Schött as the genotype.

Some three years later than Schött, Moniez used the name *Drepanura* for a species *D. brachycephala* from New Zealand. It has been shown by Denis, however, that the name was misapplied and that Moniez's species belongs to the genus *Lepidophorella*.

Drepanura cobaltina (Schött, 1917).

= *Entomobrya cobaltina* Schött.

Description.—Length, to 1·0 mm. Colour, entirely cobalt blue. Antennae scarcely twice as long as the head. Thorax II. half as long again as III. Abdomen IV. four and a half times as long as III. Ocelli, 8 on each side on dark patches. Claw with two distal teeth. Empodial appendage pointed. Mucro falciform with basal spine.

Locality.—Muresk, Western Australia, in October, 1920 (H. W.).

Drepanura citricola, n. sp. (Text fig. 11, *d.-g.*)

Description.—Length, to 2·0 mm. Colour, light yellowish-green, except for the black ocellar patches. Ocelli, 8 on each side, equal. Antennae three times as long as the head, ratio of segments = 5 : 12 : 10 : 12. Ratio of meso- to metathorax = 10 : 6. Claws with a pair of large basal teeth and two distal inner teeth. Empodial appendage lanceolate with narrow outer and broader inner lamellae. Tibiotarsal spur hair long, strong and spathulate and reaching the first of the distal teeth of the claw. Furca long, dentes annulated, mucro falciform with strong basal spine. Unannulated portion of dens twice as long as the mucro. Ratio of length of abdomen III. : IV = 1 : 3-4. Clothing of numerous long ciliated hairs which are clavate on thorax and head; on abdomen III. to V. the longer hairs are pointed and as long as the length of abdomen IV.

Locality.—Perth, Western Australia, October, 1930 (H. W.), and onwards.

Remarks.—This species is very common in the Perth area and can be got in large numbers by sweeping the native bush. It also frequents cultivated flowers in gardens and is occasionally found indoors. In the South Australian Museum

are some specimens labelled as from "Townsville, North Queensland, under boards" but without any date.

Type and *paratypes* in the South Australian Museum.

DREPANURA COERULEOPICTA (Schött, 1917).

= *Entomobrya coeruleopicta* Schött, 1917.

Description.—Length, to 1·5-2·0 mm. Colour, whitish with bluish cross bands on posterior edges of segments. Antennae $2\frac{1}{2}$-3 times as long as head. Thorax III. : IV. = 1 : 3. Ocelli, 8 on each side. Tibiotarsal spur hair as long as claw. Claw slender, with one medial and one distal inner tooth. Empodial appendage lanceolate. Ratio of manubrium to mucrodens = 1 : $1\frac{1}{2}$. Mucro falciform with basal spine.

Localities.—Waterfall Gully, South Australia, May, 1933 (H. W.); Glen Osmond, South Australia, July, 1933 (H. W.).

Remarks.—The specimens from the above localities have the bluish pigmentation somewhat more diffuse than indicated in Schött's figure.

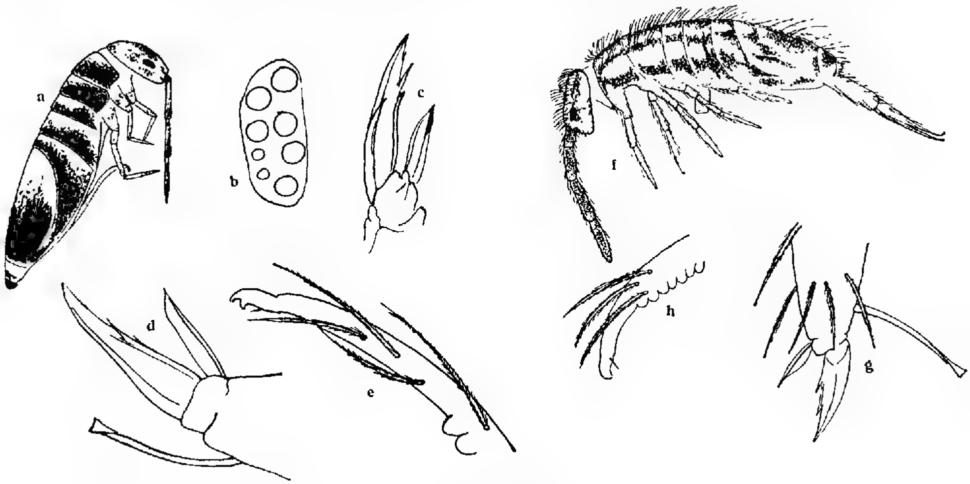

Fig. 12.

a.	*Entomobrya tasmanica*, n. sp.	Entire animal.
b.	" " "	Ocelli.
c.	" " "	Claw, empodial appendage, and tip of tibiotarsus.
d.	" " "	" " " another view.
e.	" " "	Mucro and tip of dens.
f.	*Drepanura cinquilineata*, n. sp.	Entire animal.
g.	" " "	Claw, empodial appendage, and tip of tibiotarsus.
h.	" " "	Mucro and tip of dens.

Drepanura cinquilineata, n. sp. (Text fig. 12, *f.-h.*)

Description.—Length, to 1·4 mm. Colour, yellow with five longitudinal brownish-black stripes. Antennae two and a half times as long as the head, ratio of segments = 5 : 12 : 10 : 13. Mesothorax half as long again as the metathorax. Furca reaching posterior edge of abdomen II. Ratio of manubrium to mucrodens = 17 : 24. Mucro falciform with basal spine, one-third the length of hind claw. Ocelli, 8 on each side on dark patches. Claws with basal tooth and one, more distal, tooth. Empodial appendage reaching to or just beyond the distal tooth of the claw, pointed. Clothing normal.

Localities.—On garden flowers, Bridgetown, Western Australia, June, 1932 (H. G. A.); Muresk, Western Australia, 1932 (H. W.); Mount Barker, Western

Australia, September, 1932 (H. G. A.); Victor Harbour, South Australia, January, 1934 (H. W.).

Type in the South Australian Museum.

KEY TO THE AUSTRALIAN SPECIES OF DREPANURA SCHÖTT.

1.	Unicolourous species.	2
	Species with cross-bands or longitudinal streaks.	3
2.	Entirely blue species.	*D. cobaltina* (Schött).
	Yellowish-green species.	*D. citricolor,* n. sp.
3.	Banded species.	4
	With five longitudinal stripes.	*D. cinquilineata,* n. sp.
4.	Thorax I., abdomen II., III., and most of IV. black, rest white.	*D. albocoerulea* (Schött).
	Yellowish-white with narrow bluish cross-band on abdomen III. and IV.	*D. coeruleopicta* (Schött).

Genus PSEUDOSINELLA Schäffer, 1897.

Syn. = *Lepidocyrtus* Packard, 1873; *Tullbergia* Lie-pettersen, 1896; *Sira* Schäffer, 1900.

PSEUDOSINELLA DUODECEMOCULATA Handschin, 1928. (Text fig. 13, *e.*)

Description.—Length, to 2·5 mm. Colour, yellowish-white. Ocelli, 6 on each side on a dark patch. Claw with inner tooth and basal wing-like tooth. Empodial appendage lanceolate, simple.

Locality.—Two specimens were taken in moss at Crawley, Western Australia, in 1931 (H. W.).

Pseudosinella fasciata, n. sp. (Text fig. 13, *a.-d.*)

Description.—Length, 1·5 mm. Colour (in spirit, denuded of scales), dirty yellow with a band of blue pigment on abdomen III., other segments with a slight suffusion of blue dorsally. Antennae half as long again as the head, ratio of segments = 10 : 25 : 25 : 37. Ocelli, 6 on each side as in the preceding species, on a dark patch. Mesothorax half as long again as the metathorax. Claws with a pair of basal wing-like teeth on inner side and a faint distal inner tooth. Empodial appendage broad and apically truncate. Tibiotarsal spur hair pointed. Abdomen IV. four times as long as III. Clothing of simple, oval or rounded scales. Furca stout, manubrium slightly longer than the mucrodens, both dentes and manubrium heavily scaled. Mucro bidentate with basal spine. Appendages and body segments heavily beset with setae which are finely ciliated. On the thoracic segments the setae are clavate.

Localities.—In hot-house, Perth, Western Australia, February, 1931 (H. W.); Sherbrook Falls, Victoria, April, 1931 (H. G. A.); Sassafras, Victoria, December, 1932 (H. G. A.).

Type in the South Australian Museum.

PSEUDOSINELLA SEXOCULATA Schött, 1902.

= *Pseudosinella voigtsi* Börner, 1903. *Lepidocyrtus sexoculata* Guthrie, 1903; Wahlgren, 1906; Linnaniemi, 1912.

A species very close to *P. duodecemoculata* Handschin but differing in the number of ocelli, 3 on each side instead of 6.

Locality.—Beverley, Western Australia, October 7, 1930.

PSEUDOSINELLA MARTELLI (Carpenter, 1895). (Text fig. 13, *f.*)

= *Cyphoderus martelli* Carp., 1895; *Pseudosinella immaculata* Schött, 1902; *P. argentata* Folsom, 1902; *Lepidocyrtus cavernarum* Stach, 1922.

Description.—Length, 2·0 mm. Silvery white. Ocelli entirely wanting. Body heavily scaled. Claw with a large basal wing-tooth as well as a smaller one, and with two distal inner teeth. Empodial appendage half as long as claw and with rounded outer lamella. Spathulate tibiotarsal hair present but often weak. Mucro falciform with basal spine.

Locality.—In numbers under plant pots in the hot-houses of Government House, Perth, Western Australia, in 1931 (H. W.).

Remarks.—This is a well-known species in Europe and America, occurring in caves, under stones, etc.

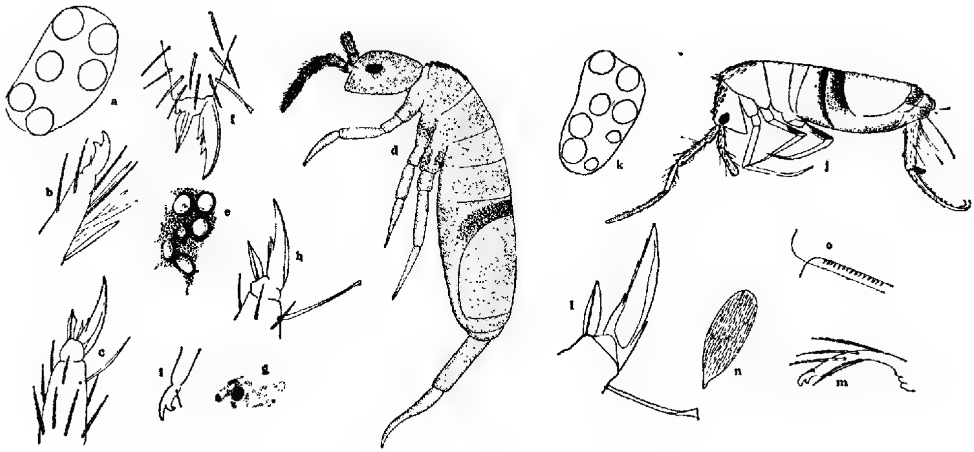

Fig. 13.

a.	*Pseudosinella fasciata*, n. sp.	Ocelli
b.	„ „ „	Mucro and tip of dens.
c.	„ „ „	Claw, empodial appendage, and tip of tibiotarsus.
d.	„ „ „	Entire animal.
e.	„ *duodecimoculata* Hndn.	Ocelli (after Handschin).
f.	„ *martelli* Carp.	Claw, empodial appendage, and tip of tibiotarsus (after Handschin).
g.	„ *unioculata*, n. sp.	Ocellus.
h.	„ „ „	Claw, empodial appendage, and tip of tibiotarsus.
i.	„ „ „	Mucro.
j.	*Mesira fasciata*, n. sp.	Entire animal.
k.	„ „ „	Ocelli.
l.	„ „ „	Claw and empodial appendage.
m.	„ „ „	Mucro and tip of dens.
n.	„ „ „	Scale.
o.	„ „ „	Spines on posterior edge of head.

Pseudosinella unioculata, n. sp. (Text fig. 13, *g.-i.*)

Description.—Length, to 0·8 mm. Colour, white, except for a little blue pigment around the deeply pigmented single ocellis on each side. Antennae half as long again as the head, ratio of segments = 6 : 10 : 10 : 20. Claws with two prominent basal wing-teeth. Empodial appendage with broad inner and narrower outer lamellae. Spathulate tibiotarsal hair well developed. Mucro bidentate with basal spine. Clothing of scales and the usual ciliated clavate hairs.

Localities.—Crawley, Western Australia, November, 1930 (D. C. S.); You Yang Mountains, Victoria, September, 1931 (J. W. R.); St. Ronan's Well, Western Australia, June, 1932 (G. E. N.).

Type in the South Australian Museum.

Remarks.—This species is parallel with *Sinella monoculata* Denis, the difference lying in the generic characters.

Key to the Australian Species of Pseudosinella.

1.	Ocelli, 6 on each side.	2
	Ocelli fewer than 6 on each side.	3
2.	Species with dark band on abdomen III. Empodial appendage apically truncate.	*P. fasciata*, n. sp.
	Species without abdominal band. Empodial appendage apically pointed.	*P. duodecemoculata* Hndn.
3.	Ocelli absent. Mucro falciform.	*P. martelli* (Carp.).
	Ocelli present.	4
4.	Ocelli, 3 on each side.	*P. sexoculata* Schött.
	Ocelli, 2 on each side.	(1) *P. alba* (Pack.) Schffr.
	Ocelli, 1 on each side.	*P. unioculata*, n. sp.

Genus Sira Lubbock, 1869.

Two species of this genus were described from Australia by Schött (226), namely, *Sira abrupta* and *S. tricincta*. There would seem to be some little doubt as to whether these are strictly members of this genus, but the species have not been rediscovered since they were first found.

Sira platani (Nicolet), 1841), f.p.

The above well-known European species was found in fair numbers under boards in a garden at Alberton, near Adelaide, South Australia, in March, 1934 (H. W.).

Handschin (127) has shown that the various European species of *Sira*—*S. platani* (Nic.), 1841; *S. flava* Agr., 1903; *S. nigromaculata* Lubb., 1870; and *S. corticalis* Carl., 1899—are all colour forms of the same species gradually increasing in the intensity of the abdominal bands until the almost black form *platani* is reached, and that as this form has priority the species should be known by that name.

The specimens from Alberton are somewhat intermediate between a dark *corticalis* and the typical *platani*.

Genus Mesira Börner, 1903; Handschin, 1925; nec. Schtscherbakow, 1898.

Mesira calolepis Börner, 1913.

Description.—Length, to 2·5 mm. Colour, in immature forms entirely yellowish, in adults with bluish pigment on side of thorax II., III., and abdomen I. with narrow bluish bands. Antennae three times as long as head, segment IV. weakly ringed and with apical sensory knob. Claws with three inner teeth and outer lateral tooth. Empodial appendage narrow with more or less truncate apex. Mucro bidentate with basal spine.

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(1) *P. alba* (Pack.) has not yet occurred in Australia, but as specimens have recently been seen from Auckland, New Zealand, it is included in the key.

This species was originally described by Börner and later redescribed by Handschin, both from material from Java. In Australia I took several specimens from under stones at Mullewa, Western Australia, in September, 1931.

MESIRA FLAVOCINCTA (Schött, 1917). (Text fig. 14, *a.-c.*)

= *Lepidocyrtoides flavocinctus* Schött, 1917.

Description.—Length, 2-5 mm. Antennae two-thirds as long as body; segment IV. ringed. Thorax II. comparatively slightly overhanging head and about twice as long as III. Abdomen IV. four times as long as III. Ocelli, 8 on each side, unequal. Tibiotarsal spur hair hardly as long as claw. Claw with four

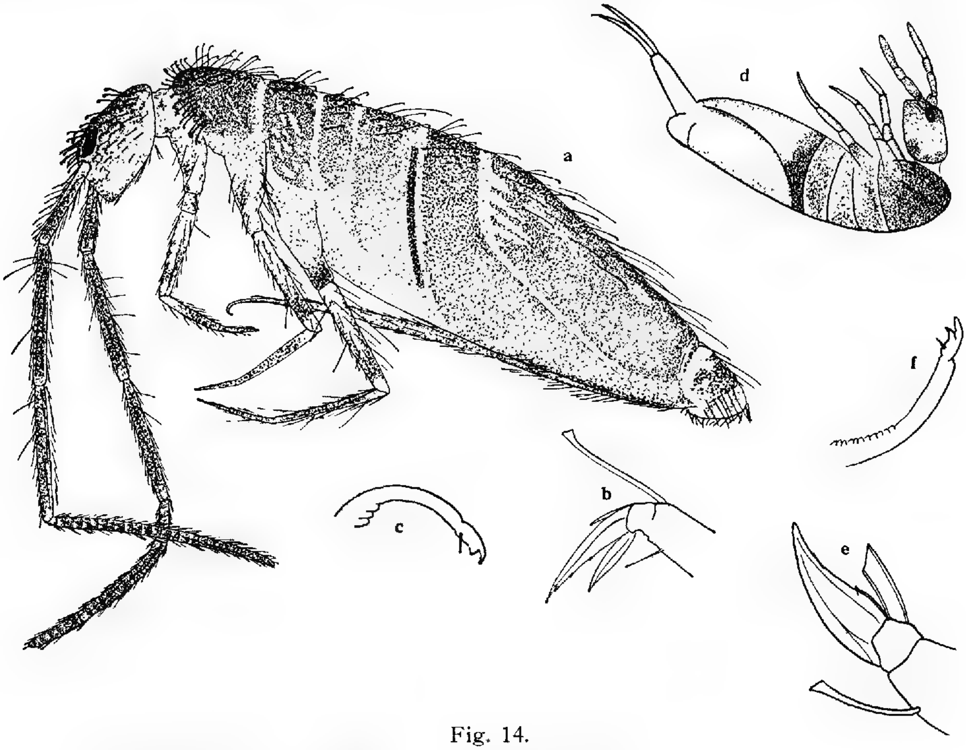

Fig. 14.

a. *Mesira flavocincta v. unicolor,* n. v. Entire animal.
b. „ „ „ „ „ Claw, empodial appendage, and tip of tibiotarsus.
c. „ „ „ „ „ Mucro and tip of dens.
d. *Lepidocyrtus nigrofasciata,* n. sp. Entire animal, without scales or hairs.
e. „ „ „ Claw, empodial appendage, and tip of tibiotarsus.
f. „ „ „ Mucro and tip of dens.

inner teeth. Empodial appendage pointed. Unringed portion of dens twice as long as mucro. Mucro bidentate with basal spine. Scales pointed or rounded with moderately long striations.

This is a common species in Western Australia, and I have seen specimens from Tasmania. The specimens nearest to the typical form as described by Schött have not the entirely white band on abdomen I. but also a little blue on this segment; the anterior part of abdomen IV. is also whitish. The majority of Western Australian specimens, however, are almost entirely blue-pigmented, except for a few light dorsal streaks. For this form I suggest the name **unicolor,** n. var.

Schött's figure shows the insect to have a characteristic convex curvature to the body. In most of my Western Australian specimens this is also the case, but in some the dorsal curvature is concave so that the mesonotum appears to be more overlapping the head than in the others. The appearance of the latter rather suggests the form of *Lepidocyrtoides*, and at first I was disposed to consider these as *Lepidocyrtoides cucularis* Schött.

Localities.—Picton Junction, Western Australia, October, 1930 (H. W.); Guildford, Western Australia, October, 1930 (H. W.); Wembley, Western Australia, November, 1930 (H. W.); Perth, Western Australia, November, 1930 (H. W.); Parkerville, Western Australia, October, 1930 (H. W.); Lesmurdie, Western Australia, October, 1930 (D. C. S.); Cascades, Tasmania, August, 1932 (V. V. H.).

MESIRA AUSTRALICA (Schött, 1917).

= *Lepidocyrtoides australicus* Schött, 1917.

Description.—Length, 3·5-5·0 mm. Colour, yellowish white, front of mesothorax and sides of body segments with bluish pigment, laterally on top of segments also with bluish stripes. Ocellar patches joined by a blue line between antennae. Antennae and appendages with bluish rings. Antennae two-thirds as long as body, IV. distinctly annulated and with terminal knob. Mesonotum only slightly overlapping head, twice as long as metanotum. Abdomen IV. from 4 to 6 times as long as III. Ocelli, 8 on each side, anterior pair large. Tibiotarsal spur hair shorter than claw. Claw with lateral tooth, proximal double tooth and two distal teeth. Unannulated portion of dens twice as long as mucro. Mucro bidentate with basal spine.

Localities.—Government House Lake, Rottnest Island, Western Australia, 1930 (L. J. G.); Belgrave, Victoria, 1931 (H. G. A. and H. F. D.); Sherbrook, Victoria, April, 1931 (H. G. A.); Morialta, Adelaide, South Australia, August, 1933 (H. W.); Victor Harbour, South Australia, January, 1934 (H. W.); Forest Hill, Queensland, December, 1932 (A. R. B.).

Remarks.—All the material that I have seen has been of the typical form as described by Schött. In his original description Schött does not mention the annulation of the IVth antennal segment. This is, however, in all my material very distinct and, therefore, the species is here placed in the genus *Mesira.*

Mesira fasciata, n. sp. (Text fig. 13, *j.-o.*)

Description.—Length, 3·0 mm. Colour, without scales, dirty yellow with black eye-patches, a black band posteriorly on abdomen II. and entirely on III., tip of V. and VI. dark, venter of abdomen, femur III. and tibiae dark blue, antennae III. and IV. bluish darker at bases and apex of III. Ocelli, 8 on each side. Antennae half as long as the body, ratio of segments = $1\frac{1}{8} : 2 : 2\frac{1}{3} : 4$, IV. annulated with apical knob, I. and II. scaled. Mesonotum slightly overhanging head, ratio of head: th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. = $3\frac{1}{2} : 2\frac{3}{4} : 1\frac{3}{4} : 1 : 1 : 1 : 5\frac{1}{2} : 1\frac{1}{2} : 1$. On the posterior edge of head where it joins the mesonotum is a collar of small spines. Furca long, ratio of manubrium to mucrodens = $3\frac{1}{2} : 5\frac{1}{2}$, mucro bidentate with basal spine, about one-third as long as unannulated portion of dens. At apex of manubrium are a few long setae. Dentes scaled. Legs long, tibiae with false joint, claws strong with outer lateral tooth and three inner teeth, one basal and two distal, empodial appendage long and simple as figured. Spathulate tibiotarsal hair present. Body scaled, scales brownish, obtusely pointed with distinct short striations.

Locality.—In debris, Brisbane, Queensland, May, 1933 (A. R. B.).

Syntypes in South Australian Museum.

Key to the Australian Species of Mesira.

1. Antennae longer than the body. Colour, whitish. Claw long and narrow, with one basal tooth and one very distal tooth on inside. *M. longicornis* (Schött).[2]

   Antennae shorter than the body. 2

2. Species of a light yellowish colour, sometimes with bluish pigment laterally. *M. calolepis* Börner.

   Species almost entirely pigmented or with lateral longitudinal marks or with cross-bands. 3

3. Species with cross-band on abdomen II. and III. *M. fasciata*, n. sp.

   Species not as above. 4

4. Species almost entirely bluish pigmented with only light longitudinal streaks, sometimes abdomen I. entirely white. *M. flavocincta* (Schött).

   Species yellowish with bluish longitudinal markings laterally and dorsally. *M. australica* (Schött).

Genus Lepidocyrtus Bourlet, 1839; Handschin, 1925.

Syn. = *Podura* Linne, 1767 (ad partem); *Poidium* Koch, 1840; *Cyphodeirus* Nicolet, 1841 (ad partem).

This genus in a strict sense is defined by Handschin, 1925 (17) as possessing hyaline scales without long striations or faint short markings, unarmed dentes, claws without wing-like basal teeth, unannulated antennae and bidentate mucro with basal spine. Schött, in his paper on the Australian forms, gives the absence of the terminal knob on the fourth antennal segment as also characteristic. Of this genus only the first two of the following species have been previously recorded from Australia.

Lepidocyrtus praecisus Schött, 1917.

Description.—Length, 1·0 mm. Colour, blue, antennae and legs blue, furca yellowish. Antennae slightly longer than the head. Claws long and narrow with only a proximal double tooth. Empodial appendage truncate apically.

Since Schött recorded this species from North Queensland specimens have been taken in sweepings at Urrbrae, South Australia, in October, 1929 (D. C. S.), and in the hot-house of Government House, Perth, Western Australia, in February, 1931. It has also been found in the You Yang Mountains, Victoria, in September, 1931 (J. W. R.).

Lepidocyrtus ralumensis Schäffer.

Description.—Length, 1·0 mm. Colour (in spirit, yellowish) in life said to be "snow white." Antennae bluish, slightly longer than head. Claws strong with two inner teeth and outer lateral tooth. Empodial appendage lanceolate, not apically truncate. Spathulate tibiotarsal hair short and fine.

Schött recorded this species from Queensland, and specimens have been received from Miss J. W. Raff taken in the You Yang Mountains, Victoria, in September, 1931.

Lepidocyrtus cyaneus Tullberg, 1871.

= *Lepidocyrtus purpureus* Lubbock, 1873; *L. violaceus* Lubbock, 1873; *L. assimilis* Reuter, 1890; *L. metallicus* MacGillivray, 1891; *L. elegantulus* Meinert, 1890; *L. anglicanus* Jackson, 1926.

Description.—Length, to 1·5 mm. Iridescent dark blue or violet. Claw with strong lateral tooth and two inner teeth. Empodial appendage lanceolate and simple.

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(2) In his paper of 1925 (29) Schött was uncertain of the correct position of his *Lepidocyrtoides longicornis*. The annulated antennae will, however, place it in the genus Mesira as understood here.

This European species is almost cosmopolitan in its distribution. It occurs commonly on cultivated ground around Perth, Western Australia, and around Adelaide, South Australia.

Lepidocyrtus nigrofasciatus, n. sp. (Text fig. 14, *d.-f.*)

Description.—Length, 0·9 mm. Colour, yellow with deep blue pigment on mesothorax, metathorax and first three abdominal segments. The basal segments of the legs, a patch between the antennae bases and the antennae light blue. Antennae as long as the head, ratio of segments = 12 : 15 : 15 : 26. Furca long, ratio of manubrium to mucrodens = 5 : 4. Body densely haired and scaled. Scales brownish but without striations or marks. Claws with lateral teeth only. Empodial appendage parallel-sided and apically truncate. Mucro normal with two teeth and basal spine.

Locality.—Kalorama, Mount Dandenong, Victoria, in June, 1932 (J. W. R.); Mount Osmond, June 6, 1934 (H. W.); Botanic Gardens, Adelaide, June, 1934 (H. W.).

Syntypes in the South Australian Museum.

Remarks.—This species is very closely related to *L. instratus* Handschin, from the Swiss National Park, but is specifically distinct in the presence of lateral teeth to the claws as well as in the greater extent of the pigmentation. The blue pigment is sometimes lighter on th. II. to abd. II., and in the specimens from the Botanic Gardens it is entirely absent, the insects being entirely yellow. To this form I give the name of var. **aureus,** v. n.

KEY TO THE AUSTRALIAN SPECIES OF LEPIDOCYRTUS.

1.	Empodial appendage truncate apically.	2
	Empodial appendage not apically truncate.	3
2.	Colour yellow with blue pigment on th. II., abd. I., II., and III. Claw with lateral teeth. Sides of empodial appendage parallel.	*L. nigrofasciatus,* n. sp.
	Entirely blue pigmented species. Empodial appendage with divergent sides.	*L. praecisus* Schött.
3.	Colour in life bluish iridescent.	*L. cyaneus* Tullberg.
	Colour in life snow-white.	*L. ralumensis* Schäffer.

Genus LEPIDOSIRA Schött, 1925.

Schött erected this genus in 1925 (29) for several species which in 1917 (28) he had included in his heterogeneous genus *Lepidocyrtoides.* He specially named *L. australicus, L. sagmarius, L. coeruleus,* and *L. cinctus,* as being species of *Lepidosira.* As type of his *Lepidocyrtoides* he retained *L. cucularis,* and also included his *L. striatus* from New Guinea. Of the remaining species he would not express any definite opinion of *L. longicornis, L. flavocinctus* and *L. angulatus* (misspelt *angustatus* in his 1925 paper). *L. spinosus* had already been transferred to a new genus *Acanthocyrtus* by Handschin (17). In this paper it is shown that *L. australicus* and *L. flavocintus* are properly included in the genus *Mesira,* and it is here suggested that from Schött's description and figures *L. longicornis* will also probably fall into the same genus.

In 1927 Schött again discussed the genus *Lepidocyrtus* and redefined it on characters quite the opposite to those of his original diagnosis. This inconsistency I have discussed elsewhere (34). The genus *Lepidocyrtoides,* as originally defined, with *L. cucularis* Schött as the genotype, can be separated from *Lepidosira* by the very much longer mesonotum, compared with the metanotum, and by this segment very much overlapping the head.

The only species of *Lepidosira* that I have been able to examine is the following:—

LEPIDOSIRA COERULEUS (Schött, 1917).

= *Lepidocyrtoides coeruleus* Schött, 1917.

Description.—General facies of *Sira*-type. Length, 2-3 mm. Colour generally blue with the lighter ground showing through as spots on thorax II. and abdomen III. Antennae lightly pigmented, twice as long as head, IV. with terminal sensory knob. Mesothorax slightly overhanging head, distinctly longer than metathorax. Abdomen IV. from $3\frac{1}{2}$ to 4 times as long as III. Ocelli, 8 on each side, the proximal elements smaller. Tibiotarsal spur hair shorter than claw. Claw with lateral tooth and four inner teeth, the proximal pair in middle of inner edge. Empodial appendage lanceolate. Dentes with lancet-like ciliated scales ventrally. Mucro bidentate with basal spine.

Localities.—Originally from Queensland, this species can now be recorded from Muresk, Western Australia, October, 1930 (H. W.); Armadale, Western Australia, June, 1932 (G. E. N.); Gooseberry Hill, Western Australia, June, 1932 (G. E. N.); Muresk, Western Australia, 1932 (H. G. A.).

Genus ACANTHOCYRTUS Handschin, 1925.

ACANTHOCYRTUS SPINOSUS (Schött, 1917). (Text fig. 15, *e*.)

= *Lepidocyrtoides spinosus* Schött, 1917.

Description.—Length, 3·0 mm. Colour entirely bluish-black, but in life often showing silvery cross-striations which vary and are apparently due to reflection. Antennae and furca light. Antennae two-thirds of body length, IV. with terminal knob. Mesothorax slightly overhanging head, twice as long as meso-

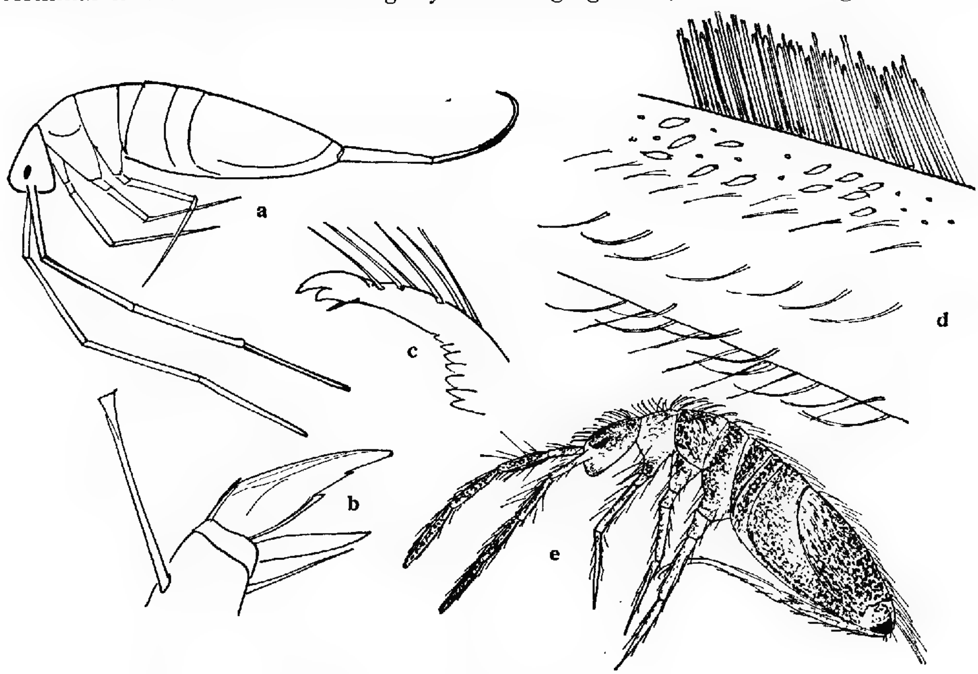

Fig. 15.

a.	*Acanthocyrtus lineatus,* n. sp.	Entire animal in outline.
b.	„ „ „	Claws, empodial appendage and tip of tibiotarsus.
c.	„ „ „	Mucro and tip of dens.
d.	„ „ „	Dental spines.
e.	*Acanthocyrtus spinosus* (Schött.)	Entire animal.

thorax. Abdomen IV. from two and a half to five times as long as III. Ocelli, 8 on each side, proximal smaller. Tibiotarsal spur hair shorter than claw. Claw with lateral tooth, proximal double teeth and one distal tooth. Empodial appendage lanceolate. Manubrium one-third longer than mucrodens. Dentes with many rows of spines and long setae. Long ciliated hairs on apical tergites of abdomen. Antennal segments with few pointed setae. Scales hyaline and striated.

Localities.—This species was first recorded by Schött from Queensland as *Lepidocyrtoides spinosus* and later placed by Handschin in a new genus *Acanthocyrtus* because of the distinctly spined dentes. It is very common and widely distributed in cultivated areas in the southern parts of both Western Australia and South Australia.

Acanthocyrtus lineatus, n. sp. (Text fig. 15, *a.-d.*)

Description.—Length, 4·0 mm. Ground colour yellowish with dark lateral stripes from head to base of abdomen IV., a few other markings laterally. Antennae dark, femora with a bluish-black subapical band, tibiotarsi with two bands, furca light. Antennae longer than body, ratio of segments $= 2\frac{1}{2} : 3\frac{3}{4} : 3\text{-}3\frac{1}{2} : 5$; IV. annulated with apical sensory knob. Ocelli, 8 on each side in two parallel rows on dark field. Ratio of th. II. : III. : abd. I. : II. : III. : IV. : V. : VI. $= 3\frac{1}{2} : 3\frac{1}{2} : 2\frac{1}{3} : 1\frac{1}{2} : 2 : 1\frac{3}{8} : 7 : 1 : \frac{1}{2}$. Ratio of manubrium to dentes and mucro $= 5 : 6 : 0{\cdot}15$; furca reaching ventral tube. Claws as figured. Dens with several rows of short stout spines and long ciliated setae. Mucro bidentate with basal spine, half the length of the unannulated portion of dens. Scales obtusely pointed, distinctly but not long striated.

Locality.—Among decaying leaves at Brisbane, Queensland, in September, 1932 (A. R. B.).

Syntypes in the South Australian Museum.

Remarks.—This species differs from the preceding in colour, length of antennae and other morphological details.

Subfamily PARONELLINAE Börner, 1906.

Genus PERICRYPTA Ritter, 1910.

This is a scaleless genus with a typical Paronelline mucro and closely allied to the genus *Salina* MacGillivray (= *Cremastocephalus* Schött). It differs in the structure of the mucro, the absence of the apical lobe of the dentes, the empodial appendage and the parallel arrangement of the ocelli. The body is humped generally and not locally as in *Campylothorax* Schött.

PERICRYPTA MJÖBERGI Schött, 1917.

Description.—Length, 2·0 mm. Colour, yellowish-white with deep blue markings as in Schött's figure. Antennae as long as body, ratio of segments $= 1 : 1\frac{1}{2} : 1\frac{1}{4} : 1\frac{3}{4}\text{-}2$, antennae IV. with pointed sensory setae. Mesonotum a little longer than metanotum. Ratio of abdomen III. : IV. $= 1 : 3\frac{3}{4}\text{-}5$. Ocelli, 8 on each side, proximal smaller. Tibiotarsal spur hair as long as claw, curved and spathulate. Claw with lateral teeth, double proximal tooth in the middle of inner edge and two distal inner teeth. Empodial appendage lanceolate. Mucrodens one and a half times as long a manubrium. Mucro with two teeth. Fine ciliated sensory setae on abdomen III. and IV.

Localities.—Originally described from Queensland, this species has been received from Adelaide, South Australia, in November, 1931, from under stones (D. C. S.); in moss, Cascades, Tasmania, in August, 1932 (V. V. H.).

Pericrypta dandenongensis, n. sp. (Text fig. 16, *a.-c.*)

Description.—Length, 1·3 mm. Colour, yellowish with blue-black pigment on metathorax; abdomen I., II. and III. dorsally. Base of antennae II. and III. also blue pigmented. The head between the ocelli and lightly on the middle of antennae I., II. and base of IV. reddish-brown. Antennae longer than body, ratio of segments = 16 : 26 : 20 : 35. Ratio of manubrium to mucrodens = 20 : 40, mucro with two teeth. Clothing of long clavate ciliated setae on dorsum and long pointed sensory setae on antennae. Claws as figured.

Locality.—A single specimen from Kalorama, Mount Dandenong, Victoria, in May, 1932 (J. W. R.).

Type in the South Australian Museum.

Pericrypta lineata, n. sp. (Text fig. 16, *d.-f.*)

Description.—Length, 4·5 mm. Colour, yellow, except for a small bluish spot between the ocellar fields, and an irregular bluish mid-dorsal line. Antennae long, I. and II. together three times as long as head (III. and IV. wanting). Ratio of

Fig. 16.

a. *Pericrypta dandenongensis,* n. sp. Entire animal.
b. „ „ „ Claw, empodial appendage and tip of tibiotarsus.
c. „ „ „ Mucro.
d. „ *lineata,* n. sp. Entire animal.
e. „ „ „ Claw, empodial appendage and tip of tibiotarsus.
f. „ „ „ Mucro.

antennal segments = 25 : 35 : ? : ?. Ocelli, 8 on each side. Claws strongly curved with two fine inner teeth, one before the middle, the other more distal; lateral teeth present but small, claw half as long again as the mucro. Empodial appendage simple, lanceolate. Furca long, ratio of manubrium to mucrodens = 3 : 4, mucro with two teeth. Clothing typical but with only a few strong abdominal setae.

Locality.—In moss, Trevallyn, Tasmania, in August, 1929 (V. V. H.).

Type in the South Australian Museum.

Remarks.—This species differs from the two preceding forms in the colour, dentition of the claws, and in the lack of strong setae on the abdominal segments, although it is possible that some of the last may have become lost.

Genus Pseudoparonella Handschin, 1921.

The old genus *Paronella* was very thoroughly revised by Handschin in 1921, so that the only two species hitherto known from Australia, *P. appendiculata* Schött and *P. queenslandica* Schött, must now be placed in *Pseudoparonella*. This genus is characterised by the mucro having only two teeth.

Pseudoparonella appendiculata (Schött, 1917).

= *Paronella appendiculata* Schött, 1917.

Description.—Colour, yellowish, with dark pigmentation on the sides and top of body. Antennae bluish. Mucro small. Claw with two distal inner teeth.

Locality.—Specimens referable to this species have been collected at Lesmurdie, Western Australia, in October, 1930 (D. C. S.).

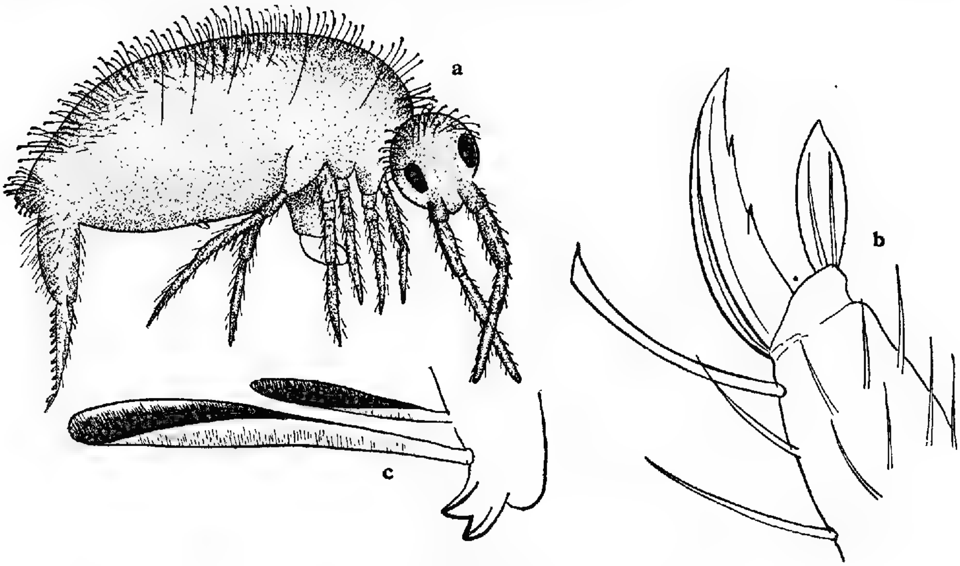

Fig. 17.

a. Pseudoparonella halophila, n. sp. Entire animal from side.
b. „ „ „ Hind foot.
c. „ „ „ Mucro and tip of dens.

Pseudoparonella halophila, n. sp. (Text fig. 17, *a.-c.*)

Description.—Length, 2·0 mm. Colour, whitish-yellow, except for the black ocellar patches and a black spot between the antennal bases. Antennae nearly three times the head length, ratio of segments = 10 : 16 : 13 : 22. III. and IV. bluish. Mesothorax one-third as long again as the metathorax. Furca long, reaching ventral tube, ratio of manubrium to mucrodens = 23 : 28, mucro with two teeth and one-third the length of hind claw. Claw with two prominent inner teeth. Ocelli, 8 on each side. Empodial appendage lanceolate with broad inner and outer lamellae.

Localities.—Type from Lake Herschel, Rottnest Island, Western Australia, in December, 1930 (L. J. G.); other specimens from amongst debris on shore of harbour at Albany, Western Australia, in October, 1930 (H. W.).

Remarks.—Differs from *appendiculata* Schött in the length of the antennae and the dentition of the claws, etc.

Type in the South Australian Museum.

Subfamily CYPHODERINAE Börner, 1906.

Genus CYPHODERUS Nicolet, 1841.

Syn. *Beckia* Tömösvary, 1882; *Boreus* Folsom, 1923.

CYPHODERUS SERRATUS Schött, 1917.

Description, 1·0-1·25 mm. Colour, white. Antennae one-third longer than the head, ratio of segments = 1 : $2\frac{1}{2}$: $1\frac{1}{2}$: $4\frac{1}{2}$, IV. with pointed sensory setae. Mesonotum slightly overhanging the head and distinctly longer than the metanotum. Abdomen IV. from 4 to 5 times as long as III. Ocelli absent. Post-antennal organ absent. Claw with lateral teeth and three inner teeth, including the two proximal wing-teeth of different size, and a strong distal tooth. Empodial appendage with large outer wing-like tooth. Ratio of manubrium : dentes : mucro = 1 : 2 — $2\frac{1}{3}$: $2\frac{3}{4}$-4. Mucrones dorsally with a series of strong teeth, 9-13 in number. Large distal outer scale of dens reaching to $\frac{4}{5}$ of mucro.

This species was described by Schött from Queensland material. It occurs widely in both Western and South Australia and is associated with ants and termites.

CYPHODERUS BIDENTICULATUS Parona, 1888. (Text fig. 18, *a.-c.*)

Description.—Length, 1·6 mm. Colour, white. Ocelli absent. Antennae half as long again as the head, ratio of segments = $1\frac{1}{2}$: 3 : $1\frac{1}{2}$: 4. Claws with large and prominent unequal wing-like proximal inner teeth and one very indistinct distal tooth. Empodial appendage slightly over-reaching the larger basal tooth of claw and with the usual outer wing-like tooth. Furca nearly half as long as body, ratio of manubrium : dens : mucro = 7 : 4 : 2; mucro with two sub-apical teeth besides the apical one. Dens with a double row of 6-7 ciliated scales,

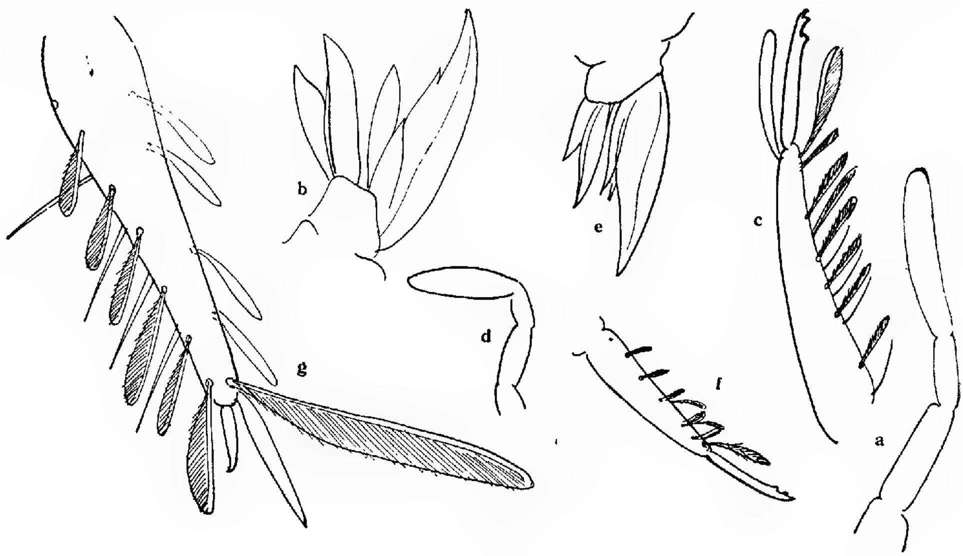

Fig. 18.

a.	*Cyphoderus bidenticulatus* Paron.		Antenna.
b.	,, ,, ,,		Foot.
c.	,, ,, ,,		Mucro and dens.
d.	,,	*adelaideae*, n. sp.	Antennae.
e.	,,	,, ,,	Foot.
f.	,,	,, ,,	Mucro and dens.
g.	,,	*nichollsi*, n. sp.	Mucro and dens.

the apical outer scale almost reaching the tip of mucro, the inner one slightly shorter.

This species is known from Europe and Natal and is closely related to the European *C. albinos,* which has only one subapical tooth to the mucro.

Locality.—Glen Osmond, South Australia, 1933, in garden soil associated with ants.

Cyphoderus adelaideae, n. sp. (Text fig. 18, *d.-f.*)

Description.—Length, 1·4 mm. Colour, white. Ocelli absent. Antennae only slightly longer than the head, ratio of segments = 1 : 2 : 1 : 3. Claws with two strong inner basal teeth, practically equal and wing-like; no distal inner tooth? Empodial appendage normal, apically truncate and reaching beyond basal teeth of claw. Furca short and stumpy, one-third of body length, ratio of manubrium : dentes : mucro = 6 : 3 : 1½, dens with two rows of ciliated scales, five on the inner row and only three larger ones on the outer row, apical outer scale reaching to proximal tooth of mucro. Mucro distinctly curved dorsally, with two subapical teeth besides the apical one.

Localities.—Burnside, South Australia, May, 1933, with termites (H. W.); Brown Hill Creek, South Australia, August, 1933, with termites (H. W.).

Syntypes in the South Australian Museum.

Remarks.—This species is rather closely related to the preceding but differs in the length and stoutness of the furca, the dental scales and the dentition of the claws.

Cyphoderus nichollsi, n. sp. (Text fig. 18 *g.*)

Description.—Length, 0·9 mm. Colour, yellowish-white. Ocelli absent. Antennae slightly longer than the head, ratio of segments = 1 : 3 : 1½ : 4. Claw with two prominent but slightly unequal inner basal teeth; distal inner teeth (?) Empodial appendage normal, not truncate apically. Furca short, ratio of manubrium : dentes : mucro = 3½ : 3 : ½, dens with two rows of ciliated scales, 6-7 in each row and about equal in length in each row, the outer distal scale is five times as long as the mucro. Mucro very short and simple, without teeth other than the slightly upturned apex. Inner apical scale of dentes two and a half times the length of mucro.

Locality.—This species was found along with ants at Kalamunda, Western Australia, in June, 1932, by Prof. G. E. Nicholls, after whom it is named.

Type in the South Australian Museum.

Remarks.—Distinctly different from other species in the structure of the mucro.

KEY TO THE AUSTRALIAN SPECIES OF CYPHODERUS.

1. Mucro small, only one-fifth the length of dentes. Inner and outer scale at apex of dentes from 2½-5 times as long as mucro. Mucro without teeth. *C. nichollsi,* n. sp.
   Mucro considerably larger. 2
2. Mucro with a series of from 9-13 strong teeth. Mucro about one-fifth longer than outer apical dental scale. *C. serratus* Schött.
   Mucro with only one or two subapical teeth. 3
3. Mucro fairly long and narrow with two small teeth, one subapical and one apical, somewhat S-shaped and slightly longer than the outer apical dental scale. *C. pseudalbinus* Schött.
   Mucro otherwise, with three teeth, two subapical and one apical. 4
4. Mucro dorsally curved. Dentes with inner row of five short ciliated scales and outer row of three larger scales. Outer distal scale of dentes not quite reaching the proximal tooth of mucro. Claw with two subequal inner basal teeth, no distal inner tooth. *C. adelaideae,* n. sp.

Mucro dorsally practically straight. Dentes with two rows of 6-7 ciliated scales of equal length. Both inner and outer distal scales of dentes almost reaching tip of mucro. Claw with two prominent but very unequal inner basal teeth and an indistinct inner distal tooth.

C. bidenticulatus Parona.

Key to the Superfamily Entomobryoidea (Collembola-Arthropleona).

A. Trochanteral organ, consisting of an area of fine hairs on hind coxae, absent. Ventral edge of claw without groove.

I. Abd. III. and IV. subequal, sometimes IV. slightly longer. With or without scales, if present then these entirely without longitudinal striae. Abdominal sensory hairs present or absent.
Family ISOTOMIDAE Schäffer, 1896; Börner, 1903.

(a) Head hypognathus. Antennae inserted in middle of head. Tracheae present. Furcal segment with two stout chitin ridges.

Subfamily ACTALETINAE Börner, 1906.
Single genus *Actaletes* Giard, 1889
(not Australian)

(a′) Head prognathus. No tracheal system. Antennae inserted in front half of head. Furcal segment without chitin ridges. Furca seldom absent. Postantennal organ mostly present.

(b) Scales present. Postantennal organ present, rosette like. Mucro long with many teeth, without hairs.

Subfamily ONCOPODURINAE Börner, 1906.
Single genus *Oncopodura* Carl and Lebedinsky, 1905
(not Australian).

(b′) Scales absent. Postantennal organ when present simple. Mucro short.

Subfamily ISOTOMINAE (Schäffer, 1898; Börner, 1913).

(c) Anus ventral, the opening being beneath or at least obliquely behind and beneath *(Folsomia)*, not terminal. Subapical papillae of antennae present or absent. Genital and anal segments large. Dorsum smooth or granular. Anal spines present or absent. Tribe Anurophorini Börner, 1905.

1. Anal spines present on abd. V. or VI. 2
   Anal spines absent. 4
2. Anal spines on abd. V. as a crown of 15-30, not on distinct papillae. Dens and mucro fused. Genus *Proctostephanus* Börner, 1906
   (not Australian).
   Anal spines on abd. VI. 3
3. Anal spines 2, small. Empodial appendage absent. Ocelli, 8 on each side. Furca absent.
   Genus *Uzelia* Absolon, 1901.
   = *Pentapleotoma* Börner, 1903
   = *Protanurophorus* Womersley, 1926
   (not Australian).

   Anal spines 4, large. Empodial appendage present. Ocelli, 8 on each side. Furca present or absent. Genus *Tetracanthella* Schött, 1891
   (not Australian).
4. Furca present, even if partially reduced. 8
   Furca absent or only represented by papillae. 5
5. Furca represented by papillae. 6
   Furca entirely absent. 7
6. Integument honeycombed. No clavate tibiotarsal hairs.
   Genus *Paranurophorus* Denis, 1928
   (not Australian).

   Integument very granular. Furcal papillae with two short chitinous salient edges. Empodial appendage and tibiotarsal clavate hairs present. Genus *Bornerella* Denis, 1925
   (not Australian).

7. Anal papilla present. Terminal knob on antennae IV. absent. Long in form, resembling *Folsomia*. Ocelli reduced.

Genus *Pseudanurophorus* Stach.
(not Australian).

Anal papillae absent. Otherwise not as above.

Genus *Anurophorus* Nicolet, 1841
(not Australian).

8. Abd. VI. more or less concealed under V. or IV. to VI. fused. 9
Abd. with all segments distinctly visible from above and separated. Furca well developed and normal. Postantennal organ present. Ocelli, 6 on each side.

Genus *Astephanus* Denis, 1926
(not Australian).

9. Abd. VI. concealed under V. Genus Cryptopygus Willem, 1906.
Abd. IV. to VI. fused 10

10. Anus distinctly ventral. Ocelli absent. Body elongate. Furca short.

Genus Isotomodes Axelson, 1907.

Anus not distinctly ventral, almost terminal. Ocelli reduced or absent. 11

11. Mucro falciform. Ocelli and postantennal organ absent. Antennae IV. with 5-6 large sensory clubs or two broad sensory lobes.

Genus Folsomina Denis, 1931,
inc. Denisia Folsom, 1932.

Mucro dentate. Postantennal organ present. Ant. IV. normal. Ocelli reduced or absent. Genus Folsomia Willem, 1902.

(c′) Anus terminal. Anal segment seldom fused to genital. Anal spines present or absent. Empodial appendage and furca usually present.

Tribe Isotomini Börner, 1913.

1. Body form elongate and cylindrical. Dens and mucro not separated. Mucro bidentate. Postantennal organ long and narrow. Ocelli present.

Genus *Folsomides* Stach, 1922
(not Australian).

Body form otherwise. 2

2. With fine sensory hairs (Bothriotricheae) on abdominal segments. 3
Without these. 8

3. Dentes with simple or serrated spines. 4
Dentes without spines. 5

4. Spines on dentes serrated. Genus **Acanthomurus,** n. gen.
Spines on dentes simple but on distinct papillae or tubercles.

Genus **Proisotomurus,** n. gen.

5. Build peculiar. Antennae III. and VI. elliptical and annulated. Ocelli, 6 on each side. Postantennal organ present. Mucro with 3 teeth. Trochanteral organ?

Genus *Architomocerura* Denis, 1931
(not Australian).

Not as above. 6

6. Antennae III. normal, II. with 15-20 sensory rods. Claw outside with a pair of long filaments. Littoral species.

Genus Axelsonia Börner, 1907.

Antennae III. normal. 7

7. Mucro with 3 teeth, the proximal two as a pair side by side and basal. Femora III. with a pointed process.

Genus *Archisotoma* Linnaniemi 1912
(not Australian).

Mucro normal with 4 teeth. Femora III. normal.

Genus Isotomurus Börner, 1903.

8. Species with clavate ciliated hairs on thoracic and abdominal segments as in Entomobrya. Abd. IV. little or much longer than III. Postantennal organ absent. 9

Species without such clavate hairs. Abd. IV. only slightly longer than III. Postantennal organ present or absent. 10

9. Mucro bidentate. Abd. IV. never much longer than III. Tibiotarsus without clavate hairs. Genus *Corynothrix* Tullberg, 1872 (not Australian).

Mucro falciform. Abd. IV. three times as long as III. Tibiotarsus with three clavate hairs. Genus **Isotobrya**, n. gen.

10. With feathered but not clavate hairs on thoracic and abdominal segments. Without scales. 11

Not as above. 12

11. Dentes without spines. Abd. IV. with two very long dorsal hairs. Genus *Alloschaefferia* Börner, 1903. (not Australian).

Dentes spined. Abd. IV. without excessively long hairs. Mucro 4-toothed, indistinctly separated from dens.

Genus *Tomocerura* Wahlgren, 1900. (not Australian).

12. Species strongly sexually dimorphic. Males always with more than long ciliated hairs on abdominal segments, which are not present in the female. 13

Species in males at most with long ciliated hairs on abdominal segments, which are not present in the females. 14

13. Male with lateral processes on abd. IV.

Genus *Guthriella* Börner, 1906 (not Australian).

Male with long curved horns on head.

Genus **Rhodesia**, n. gen.(3) for *Vertagopus minos* Den. (not Australian).

Male with chitinous spines on abd. V. 14

14. Species with 4 stout spines on papillae on abd. V.

Genus Spinisotoma Stach., 1926

Species without anal spines. 15

15. Abd. IV. equal to or shorter than III. 17

Abd. IV. longer than III. 16

16. Tibiotarsus with a single broadly spathulate tenent hair.

Genus *Pteronychella* Börner, 1909. (not Australian).

Not as above. Genus Proisotoma Börner, 1906.

† Abd. V. and VI. separated. Subgenus Proisotoma s. str. Börner, 1906.

‡ Abd. V. and VI. fused. Subgenus Isotomina Börner, 1903.

17. Claw with basal tunica. Mucro short, bidentate, with long setae overlapping it. Genus *Agrenia* Börner, 1906 (not Australian).

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(3) In his recent paper on the South African Collembola (34) the writer recorded *Isotoma (Vertagopus) minos* from Southern Rhodesia. This species, originally recorded by Denis from Italian Somaliland, was placed under *Vertagopus* by Denis because of the clavate tibiotarsal hairs. It differs remarkably, however, in the ornamented armature of the male sex, and the writer now proposes the generic name of *Rhodesia* for it. The specialized secondary horns and hairs of the male seem to justify this, as in the case of Börner's genus *Guthriella* erected for *Isotoma muskegis* Guthrie.

Claw without basal tunica. No seta overlapping mucro. Tibiotarsal clavate hairs present or not.

Genus Isotoma (Bourlet, 1839) Börner, 1906.

† Tibiotarsal clavate hairs present.

1. Abd. V. and VI fused. Furca reaching ventral tube. Mucro with three teeth. Subgenus *Pseudisotoma* Handschin, 1924 (not Australian).

2. Abd. V. and VI. free. Furca only reaching back edge or abdomen II. Mucro 4-toothed.

Subgenus *Vertagopus* Börner, 1906 (not Australian).

‡ Tibiotarsal clavate hairs absent. Furca reaching ventral tube.

Subgenus Isotoma s. str. Börner, 1906.

II. Abd. III. longer than IV., all tergites free. With or without scales, if present then with longitudinal ribs. Postantennal organ absent. Ciliated sensory setae present on abdominal segments or not. Furca present. Family TOMOCERIDAE (Schäffer, 1896).

(a) Dentes at least indistinctly annulated. Mucro small, unhaired. Antennae III. not greatly longer than IV. Subfamily LEPIDOPHORELLINAE Börner, 1906.

(b) Without scales. Mucro as in Isotomurus, small. Antennae III. and IV. and distal part of II. annulated. Dentes without spines.

Tribe **Neophorellini** n. tr.
Single genus *Neophorella* Womersley, 1933 (not Australian).

(b′) Scales present. Mucro falciform. Antennae not annulated.

Tribe **Lepidophorellini** n. tr.
Single genus Lepidophorella Schäffer.

(a′) Dentes not annulated, 2-segmented. Mucro long, haired. Antennae III. much longer than IV. Subfamily TOMOCERINAE Börner, 1906.

1. Ocelli present, 6 on each side. Tibiotarsal clavate hair present.

Genus *Tomocerus* Nicolet, 1841 (not Australian).

† Head of maxillae without beard. Subgenus Tomocerus s. str. Börner, 1908

‡ Head of maxillae with beard. Subgenus Pogonognathus Börner, 1906.

Ocelli and tibiotarsal clavate hair absent.

Genus *Tritomurus* Frauenfeld, 1854 (not Australian).

B. Trochanteral organ present on leg III. Ventral edge of claw generally with basal groove. Hairs and scales often ciliated. Abd. IV. as a rule longer than III. Furca present.

Family ENTOMOBRYIDAE Schäffer, 1896.

1. Dentes slender, annulated. Mucro small. With or without scales or ocelli.

Subfamily ENTOMOBRYINAE Börner, 1906.

(a) Antennae 4-segmented. Tribe Entomobryini Börner, 1906.

1. Body entirely without scales. 2
   Body scaled. 5
2. Body strongly convex. Furca reaching to below the head. Mucro simple, not hook-like, not distinct from dens. Antennae much longer than body.

   Genus Coelura Schött, 1917.

   Body normal. Furca shorter, mucro distinct and normal. 3
3. Claws with wing-like basal tooth. Clavate tibiotarsal hair present but weak. Tibiotarsus inside with double row of naked setae.

   Genus Sinella Brook, 1882.

   Claws normal. Clavate tibiotarsal hair well developed. 4

4. Mucro falciform. Genus DREPANURA Schött, 1896.
Mucro dentate. Genus ENTOMOBRYA Rondani, 1861.
† Dentes spined. Subgenus *Homidia* Börner, 1906 (not Australian).
‡ Dentes not spined. Subgenus ENTOMOBRYA s. str. Börner, 1906.

5. Dentes spined. 6
Dentes not spined. 8

6. Claw with basal wing-like tooth. Genus *Metasinella* Denis, 1923 (not Australian).
Claw normal. 7

7. Dental spines in a single row. Genus *Acanthurella* Börner, 1906 (not Australian).
Dental spines in a multiple series. Genus ACANTHOCYRTUS Handschin., 1925.

8. Dentes scaled. Body scales apically rounded, or if pointed then obtusely so. 10
Dentes not scaled. Scales of body acutely pointed apically, and with comparatively few long striations. 9

9. Mesonotum overlapping head. Apical segment of abdomen with a finger-like process. Antennae longer than half the body. Mucro bidentate with basal spine. Genus *Epimetrura* Schött, 1925. (not Australian).
Mesonotum not overlapping head. Apical abdominal segment without finger. Antennae shorter. Genus SIRA Lubbock, 1869.

10. Antennae III. and IV., or only IV., annulated. 11
Antennae not annulated. 13

11. Mucro falciform. Genus LEPIDOCYRTINUS Börner, 1903.
Mucro dentate. 12

12. Mesonotum very strongly overlapping head, about 4 times as long as metanotum. Genus LEPIDOCYRTOIDES Schött, 1917.
Mesonotum not so strongly overlapping head, only twice as long as metanotum. Gen. MESIRA Börner, 1903; Handschin, 1925, nec. Schtscherbakow, 1898.

13. Claw with basal wing-like tooth. 18
Claw normal, without wing-like teeth. 14

14. Scales hyaline, markings scarcely visible. Antennae IV. without retractile terminal organ. 15
Scales more chitinised, markings distinctly visible. Antennae with retractile organ at apex. 17

15. Tibiotarsal clavate hair absent. Mucro bidentate, with 2 basal spines. Claw sickle-like. Empodial appendage with strong inner angle. Genus *Trichogaster* Handschin, 1931 (not Australian).
Not as above. 16

16. Mucro bidentate with basal spine. Genus LEPIDOCYRTUS Bourlet, 1839.
Mucro falciform. Genus *Drepanocyrtus* Handschin, 1925 (not Australian).

17. Mucro dentate. Genus LEPIDOSIRA Schött, 1896
Mucro falciform. Genus PSEUDOSIRA Schött, 1896. = *Mesira* Schtscherbakow, 1898.

18. Empodial appendage also with wing-like tooth. Genus *Lepidosinella* Handschin, 1919 (not Australian).
Claw only with wing-like tooth. 19

19. Basal wing-like tooth of claw single, scale-like. Genus *Sirodes* Schäffer, 1897. (not Australian).

With a pair of well-developed basal wing-like teeth to claw.

Genus PSEUDOSINELLA Schäffer, 1897.

(a') Antennae 5 to 6 segmented, I. or II. subdivided (seldom 4-segmented, if so then IV. as long as body). Mucro bidentate with basal spine.

Tribe ORCHESELLINI, Börner, 1906.

1. Without scales. Antennae 6-segmented. Abd. IV. twice as long as III.

Genus *Orchesella* Templeton, 1835 (not Australian).

With scales. 2

2. Antennae 4-segmented, IV. thickly annulated and longer than body. Abd. IV. only a little longer than III. Genus *Typhlopodura* Absolon, 1900 (not Australian).

Antennae 5 to 6-segmented. Abd. IV. 3 to 8 times as long as III. 3

3. Apex of abdomen with a long articulate process.

Genus *Heteromuricus* Imms, 1912 (not Australian).

Without this process. 4

4. Antennae 5-segmented, IV. and V. or only IV. annulated. 5

Antennae 6-segmented, V. and VI. annulated Dentes spined.

Genus *Dicranocentrus* Schött, 1896 (not Australian).

5. Species without dental spines. 6

Species with spined dentes. Genus *Alloscopus* Börner, 1906 (not Australian).

6. Abd. IV. not more than 5 times as long as III.

Genus *Heteromurus* Wankle, 1861 (not Australian).

† Antennae V. annulated, Ocelli 2 or nil.

Subgenus *Heteromurus* s. str. Handschin, 1929.

‡ Antennae IV. and V. annulated. Ocelli absent.

Subgenus *Verhoeffiella* Absolon, 1900.

Abdomen IV. about 8 times as long as III. Antennae IV. not annulated. Thorax II. overhanging head. Genus *Strongylonotus* MacGillivray, 1894 (not Australian).

II. Dentes not annulated, not or only very slightly tapered apically.

(a) Dentes without fringed scales or setae dorsally, similarly haired dorsally or dorsolaterally. Dental spines present or absent. Empodial appendage with 4-winged edge. Mucro plump, separated or not from dens. With or without scales. In all known forms with ocelli and free living. Subfamily PARONELLINAE Börner, 1906.

1. Scales species. 4

Without scales. 2

2. Dentes distally, near base of mucrones with a scale-like appendage Antennae twice as long as body. Mucro bidentate. Genus SALINA MacGillivray, 1894. = *Cremastocephalus* Schött, 1896.

Dentes without this appendage. 3

3. Mucro not distinctly separated from dentes. Antennae more than twice as long as body, and beneath with long, stiff setae, which are almost as long as segment. Mucro bidentate. Genus *Chaetoceras* Handschin, 1926 (not Australian).

Mucro separated, from dentes, with 2 teeth. Antennae not longer than body and without above setae. Body strongly convex longitudinally.

Genus PERICRYPTA (Ritter, 1910) Schött, 1917.

4. Body strongly humped in thoracic region. 5
Body normal. 6

5. Hump most pronounced on mesothorax. Antennae 5-segmented. Mucro with 5 teeth.
Genus *Idiomerus* Imms, 1912 (not Australian).

Hump most pronounced on metathorax. Abd. IV. very long and basally bent almost at right angles with III. Dentes spined or not.
Genus *Campylothorax* Schött, 1893 (not Australian).

6. Antennae half as long as body, I. and II. densely clothed with long black setae. Dentes spined. Mucro with 5 teeth.
Genus *Dicranocentroides* Imms, 1912 (not Australian).

Antennae normal. 7

7. Mucro with 2 to 4 teeth, small. Dentes spined. 8
Mucro with 5 to 7 teeth. 10

8. Spines of dentes simple. 9
Spines of dentes compound or serrated. Mucro indistinctly separated from the dens, with 3 teeth. Largest median tooth of dens upturned.
Genus *Bromacanthus* Schött, 1925 (not Australian).

9. Mucro with only two teeth, often reduced to a stump.
Genus PSEUDOPARONELLA Handschin, 1925.

Mucro with 3 to 4 teeth, always well developed.
Genus *Paronella* (Schött, 1893) Handschin, 1925 (not Australian).

10. Dentes with small blister or scale-like appendage apically.
Genus *Microphysa* Handschin, 1925 (not Australian).

Dentes without this appendage. Genus *Aphysa* Handschin, 1925 (not Australian).

(a′) Dentes dorsally with ciliated or fringed scales or spines. Empodial appendage with 3-winged edge, or more or less reduced. Blind and scaled species.
Subfamily CYPHODERINAE Börner, 1906.

(b) With an inner dorsal row of ciliated spines on dentes. Mucro at right angles to dens. Free living forms in caves.
Tribe TROGLOPEDETINI Börner, 1906.
Single genus *Troglopedetes* Absolon, 1907 (not Australian).

(b′) With a double row of fringed scales on dentes. Termitophilous or myrmecophilous forms. Tribe CYPHODERINI Börner, 1913.

1. Mandibles with normal molar plate. 2
Mandibles stylet-like, without molar plate. Body cylindrical. Mucrones claw-like. Clothing different in male and female.
Genus *Calobatella* Börner, 1913 (not Australian).

2. Claw lobe-like with basal spine. Empodial appendage normal or rudimentary. Genus *Cyphoderodes* Silvestri, 1911 (not Australian).

Claw of normal structure. Empodial appendage with wing-like tooth. 3

3. Head of normal prognathus form. Mandibles with well-developed molar plate. Dentes mostly with 5 inner and 6 outer dorsal scales.
Genus CYPHODERUS Nicolet, 1841.

Head hypognathus. Mandibles small with ornamented molar plate. Dentes only with 2 to 3 inner and 5 outer dorsal scales. Mucrones small. Antennae II. to V. with small curved sensory hairs.
Genus *Pseudocyphoderus* Imms, 1912 (not Australian).

Selected Bibliography.

Owing to the necessity for economy of space, this bibliography only contains the papers actually cited in the text, together with a few of the more important and recent works. The latter will be found to contain very full lists of the literature on the Collembola.

The numbers quoted in Part I., Poduroidea, of this paper, published in these Proceedings, 1933, will necessarily be altered as follows:—29 (1), 35 (2), 38 (3), 44 (4), 68 (5), 82 (6), 84 (7), 158 (21), 168 (23), 177 (24), 198 (26), 226 (28), 238 (31), 241 (32), 265 (33).

(1) Bell, H. D. 1919—Insect Life on Sewage Filters. *London.*

(2) Börner, C. 1902—Das Genus Tullbergia Lubbk. *Zool. Anz.*, **vol. xxvi.** 123.

(3) ,, ,, 1906—Das System der Collembolen, nebst Beschreibungen neuer Collembolen des Hamburger Naturhistorischen Museums. *Mit., Nat. Hist. Mus., Hamburg.* 147.

(4) ,, ,, 1913—Die Familien der Collembolen. *Zool. Anz.*, **vol. xli.** 315

(5) Carpenter, G. H. 1905—*Proc. Assoc. Econ. Biol.*, **vol. i.** 14.

(6) Collinge, W. E. 1906—Rept. on Injurious Insects in the Midland Counties During 1905. *Birmingham.*

(7) ,, ,, ,, 1912—Springtails. *Manual of Injurious Insects.* 22-24.

(8) Denis, J. R. 1931—Collemboles de Costa Rica avec une Contribution au Species de l'Order. *Boll. Lab. Zool. Portici.*, **vol. xxv.** 69-170.

(9) ,, ,, ,, 1933—Contributo alla conoscenza del "Microgenton di Costa Rica." *Boll. Lab. Zool. Portici.*, **vol. xxvii.** 222-322.

(10) Folsom, J. W. 1913—North American Springtails of the Subfam. Tomocerinae. *Proc. U.S. Nat. Mus.*, **vol. xliv.** 451.

(11) ,, ,, ,, 1916—North American Collembolous Insects of the Subfamilies Achorutinae, Neanurinae and Podurinae. *Proc. U.S. Nat. Mus.*, **vol. l.** 477.

(12) ,, ,, ,, 1917—North American Collembolous Insects of the Subfamily Onychiurinae. *Proc. U.S. Nat. Mus.* 53

(13) ,, ,, ,, 1933—Economic Importance of Collembola. *J. Econ. Entom.*, **vol. xxvi.** 934-939.

(14) Guthrie, J. E. 1903—The Collembola of Minnesota. *Geol. Nat. Survey Minnesota.* 4.

(15) Handschin, E. 1920—Collembola aus Java. *Rev. Suisse Zool.*, **vol. xxviii.** 8, 135.

(16) ,, ,, 1920—Die Onychiurinen der Schweiz. *Verh. Nat. Ges., Basel*, **vol. xxxii.** 1.

(17) HANDSCHIN, E. 1925—Beitraäge zur Collembolenfauna der Sunda-inseln. *Treubia.* 228.

(18) „ „ 1929—Urinsekten oder Apterygota. *Die Tierwelt Deutschlands.* 16.

(19) IMMS, A. D. 1912—On some Collembola from India, Burma, and Ceylon. *Proc. Zool. Soc. London.* 80.

(20) „ „ „ 1906—Anurida. *L'pool Marine Biol. Mem.* 13.

(21) LINNANIEMI, W. M. 1907-12—Die Apterygotenfauna Finlands. *Acta. Soc. Sc. Fennicae,* **vol. xl.**

(22) LUBBOCK, J. SIR 1873—Monograph of the Collembola and Thysanura. *Ray Soc. London.*

(23) „ „ „ 1899—On some Australasian Collembola. *Jour. Linn. Soc. London.* (Zool.), **vol. xxvii.** 334.

(24) MATSUMATA, S. 1930—Studies on Onychiurus Injurious to Wheat Shoots. *Rev. Applied Entom. A.* Oct.

(25) MILLS, H. B. 1934—A Monograph of the Collembola of Iowa. *Collegiate Press, Ames, Iowa.* 1.

(26) RAINBOW, J. W. 1907—Two New Species of Australian Collembola. *Rec. Aust. Mus.,* **vol. iv.** 313-4.

(27) SCHÖTT, H. 1901—Apterygoten von Neu-Guinea und den Sundainseln. *Termeszetrajzi Fuzetek.,* **vol. xxiv.**

(28) „ „ 1917—Collembola in Results of Dr. E. Mjöberg's Swedish Exped. to Australia in 1908-13. *Ark. f. Zool.,* **vol. ii.**

(29) „ „ 1925—Collembola from Mt. Murud and Mt. Dulit, in Northern Sarawak. *Sarawak Museum Journal,* **vol. iii.,** pt. 1, No 8. 107-127.

(30) „ „ 1927—Kamerunische Collembola. Linkoping.

(31) STACH, J. 1929—Die Gattung Brachystomella Agr. (Collembola) und ihre Arten. *Bull. Acad. Pol. Sc. Lettres.* (1928), p. 355.

(32) THEOBALD, F. V. 1910—Springtails (Collembola). Their Economic Importance with Notes on some Unrecorded Instances of Damage. *Rept. les Congres Internat. d' Entom. (Bruxelles),* 2, 1-18.

(33) WOMERSLEY, H. 1928—A New British Species of Collembola. *Ann. Mag. Nat. Hist.,* ser. 10, 2.

(34) „ „ 1934—On some Collembola-Arthropleona from South Africa and Southern Rhodesia. Annals South African Mus., **vol. xxv.,** pt. 3, pp. 441-475.

SOME AUSTRALIAN ANAPORRHUTINE TREMATODES.

BY PROFESSOR T. HARVEY JOHNSTON

Summary

Early in the present year three species of *Probolitrema, P. rotundatum, P. clelandi* and *P. simile,* were described from South Australian elasmobranches (Johnston, 1934). The last two, from the same host, were stated to be closely related and perhaps synonyms. Since additional material of these species has become available for study, the opportunity was taken to re-examine the late Professor S. J. Johnston's type slides of *Petalodistomum cymatodes* and *P. polycladum,* for which thanks are tendered to Professor Harvey Sutton of the School of Public Health and Tropical Medicine, University of Sydney.

SOME AUSTRALIAN ANAPORRHUTINE TREMATODES.

By Professor T. Harvey Johnston, University of Adelaide.

[Read September 13, 1934.]

Early in the present year three species of *Probolitrema, P. rotundatum, P. clelandi* and *P. simile,* were described from South Australian elasmobranchs (Johnston, 1934). The last two, from the same host, were stated to be closely related and perhaps synonyms. Since additional material of these species has become available for study, the opportunity was taken to re-examine the late Professor S. J. Johnston's type slides of *Petalodistomum cymatodes* and *P. polycladum,* for which thanks are tendered to Professor Harvey Sutton of the School of Public Health and Tropical Medicine, University of Sydney.

Staphylorchis cymatodes (Johnston) Travassos.

This species, originally described as *Petalodistomum cymatodes* by S. J. Johnston (1913, 392), was based on a single specimen collected from the body cavity of a spotted stingray (leopard ray), *Dasyatis kuhlii* M. & H., from Townsville, North Queensland.

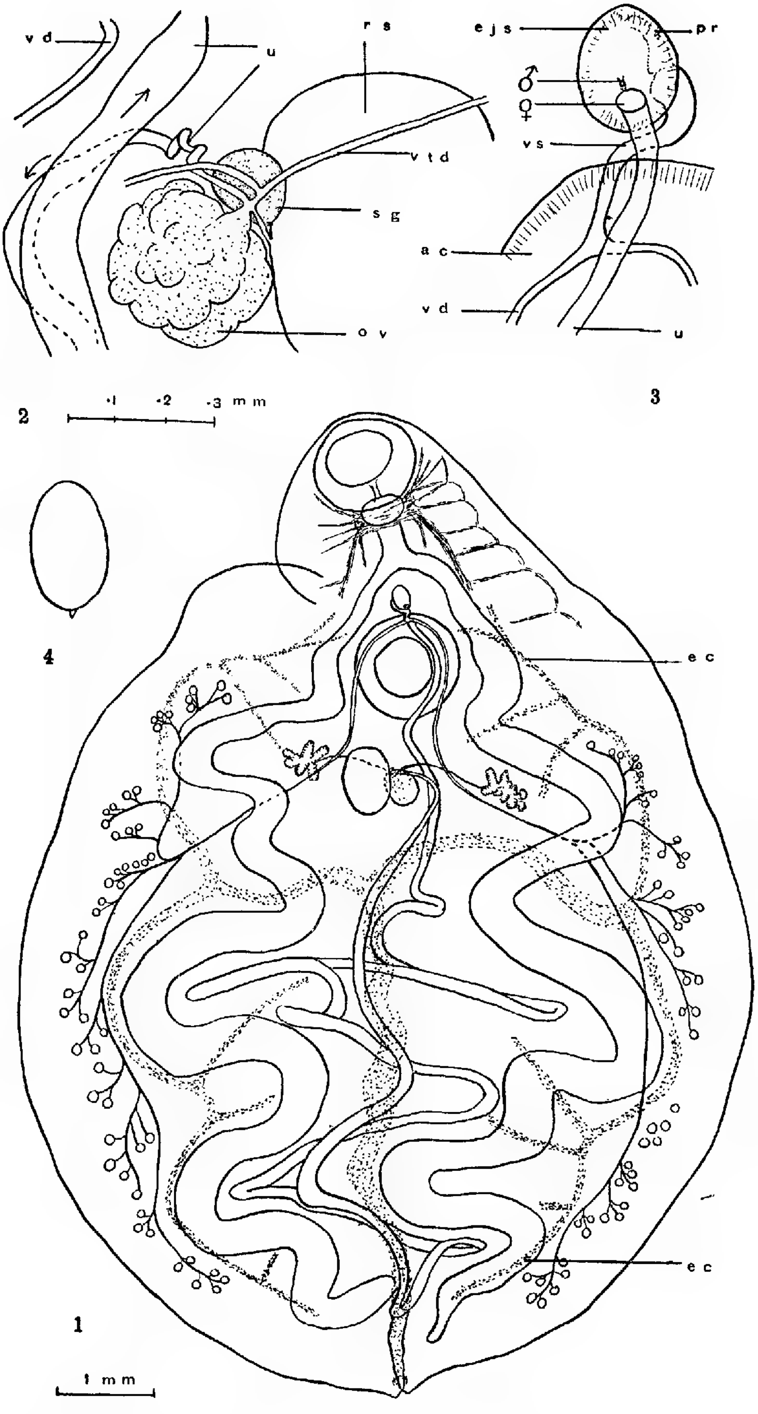
Mainly on account of the characters of the testes and intestine, Travassos (1922, 226) erected the genus *Staphylorchis* for it, giving the following diagnosis:—Anaporrhutinae; body flat, broad; pharynx present; intestinal crura sinuous, without diverticula; vitellaria intracaecal; testes extracaecal, very small and numerous. He regarded it as being nearer to *Anaporrhutum* than to *Petalodistomum.* Fuhrmann (1928, 112) referred to the genus as *Straphylorchis.*

Thanks to the kindness of Professor Harvey Sutton, School of Public Health and Tropical Hygiene, University of Sydney, the type slide was made available for further study. The form and general anatomy are shown in Johnston's figure, but a closer examination of the specimen has permitted an amended and more detailed account, especially of the reproductive and excretory systems.

S. cymatodes is a large trematode, 10·4 mm. long by 1·7 mm. broad, with the suckers approximately equal in diameter (1·1 mm.). The genital pore lies a short distance in front of the acetabulum. The pharynx is somewhat lens-like, 0·50 mm. broad by 0·31 mm. long. There is a rather wide oesophagus. The crura are at first narrow, gradually widening, being broadest in their posterior half. They are thrown into a number of wide undulations and terminate near the end of the worm.

The specimen has the brain and main nerves arising from it well shown. The brain has the usual position above the pharynx and from it are given off, more or less symmetrically, nerves passing forwards along the anterior sucker, several short ones laterally and a long dorsal and ventral from each posterior corner, the ventral being the larger. The latter travels posteriorly in close association with the intestine. It gives off numerous lateral nerves which all become connected with a lateral nerve near the margin of the parasite. The dorsals were not traced backwards.

The main excretory canals were traceable in the specimen. The vesicle is tubular and extends a great deal further forward than the original figure indicates. A little distance behind the ovary this longitudinal canal bifurcates, each branch passing outwardly to meet the corresponding lateral vessel in the vicinity of the mid-length of the worm. The connections shown in the original figure, between the posterior end of each lateral canal and the vesicle, are incorrect. The course



Figs. 1-4.

Staphylorchis cymatodes.—1, Type, dorsal; 2, female complex, ventral; 3, region of genital pore, ventral; 4, egg. a c, acetabulum; e c, excretory canal; e j s, ejaculatory sac; o v, ovary; p r, prostate; r s, receptaculum seminis; s g, shell gland; t, testis; u, uterus; v d, vas deferens; v s, vesicula seminalis; v t d, vitelline duct.

of the tubes arising from the lateral vessels is indicated in fig. 1. From the anterior branch, one is given off to the vitelline region, one to the area just in front of it, and the bifurcate end drains the part between the suckers. The posterior branch is the larger and from it arise two tubes near one another, and a smaller one further back. The main excretory ducts are thus disposed more like those of *Anaporrhutum*.

The type specimen has 47 round testes on one side and 52 on the other. They lie extracrurally extending from just in front of the level of the vitellaria to a point a short distance in front of the end of the crura. They are about 0·1 mm. in diameter. The arrangement of the ducts shows that though the vesicles appear to form a continuous series there are really three groups of them on each side, a small anterior group of 13 to 17, a middle group of about 12 to 15, and a posterior group comprising the remainder. Each vesicle is continuous with a delicate duct and groups of two to four of these efferent tubules join to enter the larger ducts. The anterior vas deferens passes backwards close to the crus (and may lie below a loop of it) to join the middle posterior vas a short distance behind the level of the ovary. The posterior vas is the largest duct and may or may not underlie a lobe of the crus. It travels forwards near the excretory canal, its anterior part lying inwardly from, and approximately parallel to, the middle vas. It meets the combined anterior and middle ducts, and then passes inwards below the intestine and forwards diagonally just inwardly from the corresponding yolk gland. At the level of the ovary it bends forwards, travelling above the acetabulum and inwardly from the crura. The two vasa meet above the anterior margin of the ventral sucker, to form a small vesicula seminalis. This travels forwards near the midline above the metraterm and ejaculatory sac, and enters the latter in its anterior region. The walls of the sac are thickened, probably due to the presence of prostate glands. The structure is about 0·28 mm. long by 0·2 mm. broad. The male aperture is adjacent to the uterine pore, but the exact relationships were not made out. The arrangement appears to be very like that figured by Looss (1902, pl. 23, fig. 32) for *Plesiochorus cymbiformis*, except that the vesicula is quite small.

The ovary is median, a little distance behind the ventral sucker. It measures about 0·32 mm. broad by 0·32 mm. long and has a number of low, broad, rounded projections, the organ appearing rather compact. The short, wide oviduct travels forwards and inwards and, after receiving the tiny duct from the receptaculum, enters the shell gland which lies in front of it in an angle made by the receptaculum and the anterior border of the ovary. The seminal receptacle is rounded, 0·53 mm. long by 0·67 mm. wide, lying slightly to one side of the midline. The shell gland measures 0·15 by 0·18 mm. The fertilizing duct, after traversing it, becomes thrown into a few very short convolutions immediately in front of the ovary and then passes, as the uterus, below the descending limb of that organ. Its course is thus different from that previously described, and is similar to that in other Anaporrhutine trematodes. It now follows a more or less median course until it reaches the region between the ends of the crura. It then becomes thrown into a few wide loops in the post-ovarian part of the body, the loops extending almost from one crus to the other. It eventually passes forwards above the early portion of the duct, then to one side of, and close to, the ovary and forwards above the acetabulum to terminate just in front of it and just behind the cirrus sac. Very few eggs are present in the type, and most of them are very distorted. A typical specimen measured 0·05 by 0·028 mm. and possessed a small terminal projection. The largest egg observed measured 0·065 by 0·040 mm., excluding the "spine." The projection varied considerably in length, being most marked in under-sized eggs. S. J. Johnston gave 0·06 to 0·064 by 0·03 mm. as the dimensions. The yolk glands lie internally to the crura and

very slightly in front of the level of the ovary. Each consists of a branched tube, the branches being short and rounded and clustered at the end of the yolk duct. The two ducts pass almost directly inwards just in front of the ovary, one of them lying ventrally to the anterior region of the receptaculum. They join below the shell gland, and a very short, common duct passes back to unite with the fertilizing duct just after its junction with the canal from the receptaculum and immediately before it enters the shell gland.

Our study of the type indicates that *Staphylorchis* is more closely related to *Anaporrhutum* than to any of the other genera in the subfamily, but differs from it in the extracaecal distribution of the minute spherical testes; the completely intercaecal position of the vitellaria; and the sinuous form of the intestinal crura. In the last of these characters, as well as in the form of the excretory vesicle and of the testes, it differs from *Petalodistomum,* which also has a branching intestine.

In 1930 Nagaty republished Johnston's figures (in part) and gave a generic diagnosis evidently based on Travassos. He also reviewed the Anaporrhutinae, giving a tabulated comparison of the chief anatomical features of the genera assigned to the subfamliy.

Baylis (1927, 426) transferred *Anaporrhutum largum* Luehe, 1906, to *Staphylorchis,* and gave a figure of a specimen from *Stegostoma tigrinum* from Madras. Luehe's material came from the coelome of a Cingalese ray, *Rhinoptera javanica.* Southwell (1913, 101) recorded it as *A. largum* from *Chiloscyllium indicum, Ginglymostoma concolor* and *Aetobatis narinari* from Ceylon, and mentioned that a species of *Anaporrhutum* was taken from *Stegostoma tigrinum* off Orissa. He referred to certain differences between the specimens from these two localities, but thought that they probably belonged to the same species.

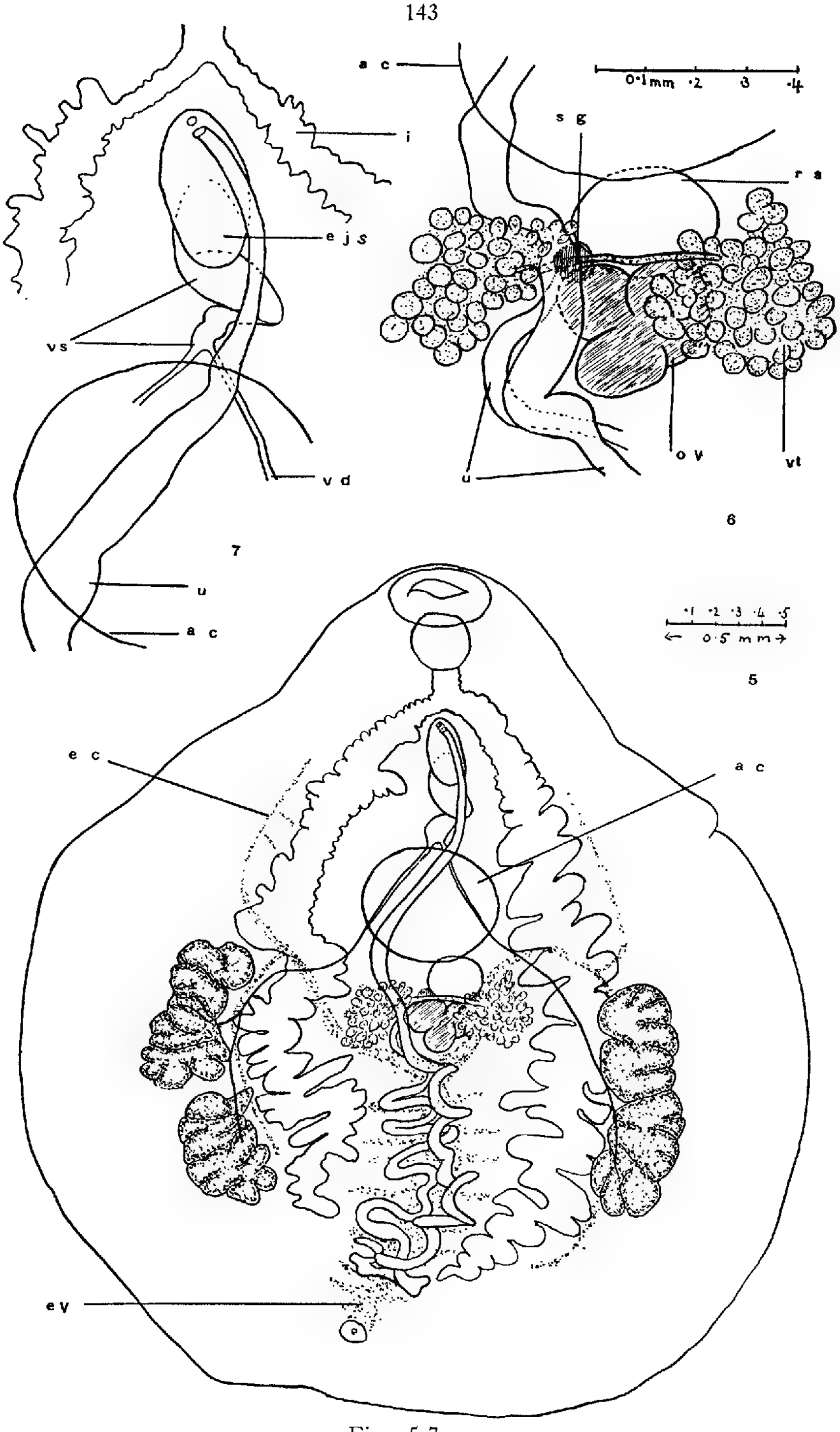
Nagaty (1930, 102) gave a brief account of *S. largus* from *Ginglymostoma concolor* from Ceylon. Some of his specimens showed amphitypy, as he stated that the ovary and metraterm occurred on either the right or the left of the mid-line. He mentioned that the excretory vesicle was Y-shaped.

Judging from Baylis' account, *S. largus* is more circular in outline; it has larger and fewer testes, and these are much more restricted in distribution; the lateral regions of the body are much more extensive; the intestinal folds are much closer, more numerous and less regular; the uterine folds occupy a much more restricted region, and there is a marked difference in the sizes of the two suckers, the ventral being 2½ times the oral in diameter. The testes, though few in number, were found by Baylis to be unequal on opposite sides, just as Luehe had observed. A similar condition occurs in the type specimen of *S. cymatodes.*

Petalodistomum polycladum S. J. Johnston.

This species was obtained from the body cavity of *Dasyatis kuhlii* M. & H., from North Queensland (S. J. Johnston, 1913, 389-92). Thanks to the kindness of Professor Harvey Sutton, the type slide and a series of sections were made available for further study. Unfortunately the series is somewhat incomplete and disarranged and obviously made from a distorted specimen. These defects have prevented a more satisfactory account of the excretory system being given. The type is small and almost round, 3·76 mm. long by 3·5 mm. broad, narrowing somewhat in the anterior third, but with a broadly rounded posterior region. S. J. Johnston (1913, 390) reported that the length of his specimens varied between 3·3 and 3·7 mm., and the breadth between 3 and 3·5 mm. The type must have been his largest specimen.

The oral sucker has a diameter of 0·44 mm. and the ventral 0·65, the ratio being 1 : 1·47, the original account stating that the oral ranged from 0·375 to 0·424 and the ventral from 0·636 to 0·652 mm., the ratio being 1 : 1·6. The



Figs. 5-7.

Petalodistomum polycladum.—5, Type, ventral, position of male ducts and excretory system added from serial sections; 6, female complex—ventral; 7, region of sex apertures, ventral, composite figure from type and sections. Figs. 6 and 7 drawn to same magnification. a c, acetabulum; e c, excretory canal; e j s, ejaculatory sac; e v, excretory vesicle; i, intestine; o v, ovary; r s, receptaculum seminis; s g, shell gland; u, uterus; v d, vas deferens; v s, vesicula seminalis; v t, vitellarium.

pharynx is 0·25 mm. in diameter and is succeeded by a short oesophagus. The crura which terminate some distance from the posterior end, possess numerous short, irregular sacculations or short, wide branches given off from both the inner and outer surfaces. These irregularities are also present, though small, in the region of the bifurcation also. The intestine is remote from the lateral edges of the worm.

The serial sections do not allow of information additional to that in the original account being given regarding the nervous system. The excretory pore is definitely dorsal, about midway between the posterior limit of the uterus and the end of the parasite. The vesicle extends forwards above the uterus to the hind margin of the ovary, then bifurcating, the limbs extending outwards and forwards above the vitellaria, one limb being adjacent to the outer edge of the seminal receptacle. They then pass below the intestine and, at about the level of the rear edge of the acetabulum, each branches into a shorter anterior and a larger posterior excretory canal lying immediately laterally from the intestine. The posterior canal occupies a position between the latter and the corresponding testis. The point of origin and the course of the ducts entering the lateral canals could not be determined satisfactorily from the material under examination. The main vesicle is not a simple tube but, as Johnston has stated, possesses a number of lateral projections.

The testis of each side lies laterally from the intestine and close beside it. Each extends forwards practically to the mid-length of the worm, and thus lies behind the level of the posterior end of the acetabulum. The posterior fifth of the body is free from them. Each testis forms one or two masses and presents a much lobulated surface, the lobes being short, broad, and closely set. The testicular ducts from the anterior and posterior portions of the gland lie near the inner margin. They join near the middle of the organ to form the vas deferens which travels forwards and inwards below the intestine at about the level of the receptaculum. The vasa pass close to the inner side of the corresponding caecum, one vas lying between the latter and the metraterm. They meet in the midline just above the anterior edge of the acetabulum and form a swollen seminal vesicle which becomes thrown into a few short convolutions lying above the metraterm. The ejaculatory sac is rather small (about 0·3 mm. long by 0·15 mm. broad) and lies below and in front of the anterior end of the vesicula. Its walls are considerably thickened owing to the presence of gland cells. There is a narrow canal leading from the sac downwards to the male pore which is situated immediately in front of the uterine aperture, the two lying just behind the intestinal bifurcation.

The ovary has three rounded lobes, two anterior and one posterior. It measures 0·32 mm. in maximum breadth by 0·28 mm. in length, and is about 0·8 mm. in diameter. It lies on the right of the midline above the right anterior ovarian lobe, and is in close contact with the rounded receptaculum. The latter, which measures 0·29 mm. in breadth and 0·22 mm. in length is situated just to the left of the midline immediately in front of the ovary and partly overlaps it. It lies adjacent to the posterior margin of the acetabulum. Its extremely narrow duct arises posteriorly and travels inwards between the ovary and receptaculum, joining the short oviduct very close to the ovary. The fertilizing duct passes diagonally forwards through the shell gland, then becomes slightly twisted and widened and passes back directly above the descending limb of the uterus. The two limbs keep rather close company and occupy a restricted median region, which extends posteriorly a little beyond the ends of the intestine, but does not reach the crura laterally. The descending limb passes forwards to the right of the ovary, which it may partly underlie, below the shell gland and to the right of the receptaculum. In the type it passes below the yolk duct but above some of

the right vitelline lobes. It then travels above the acetabulum, becoming median. Its terminal portion, the metraterm, was seen, in section, to be thrown into numerous small ridges. This region passes below one of the vasa deferentia, the vesicula and the ejaculatory sac. The female pore lies immediately behind the male aperture, the two being confluent. As S. J. Johnston states, eggs measure 0·052 to 0·063 mm. by 0·023.

The vitellaria occupy a restricted region intercrurally on either side of the ovary. Each has about forty or fifty small rounded projections in the type, though S. J. Johnston mentioned that the gland was composed of 15 to 20 small rounded follicles. Nagaty (1930, 104), in his tabulation of the main characters of the species, states that the vitellarium consists of "small spherical follicles." They are really short tubular processes. Some of those belonging to the left gland underlie part of the ovary and receptaculum. The transverse yolk duct lies ventrally immediately in front of the ovary and underlies part of the receptaculum and the shell gland. A common duct passes upwards in a curved course to lie between the shell gland and the ovary, joining the fertilizing duct in the vicinity of the former.

S. J. Johnston's original generic diagnosis included *Petalodistomum cymatodes* which Travassos removed to a new genus, *Staphylorchis*. Nagaty (1930, 106), in his review of the Anaporrhutine trematode genera, amended slightly Johnston's diagnosis. Our examination of the type does not necessitate any further modification. The generic characters may be stated briefly thus:—Anaporrhutinae; intestinal caeca with numerous sacculations; testes lobed, extra-crural; vitellaria composed of numerous tubular lobes, intercrural; excretory vesicle with numerous lateral diverticula.

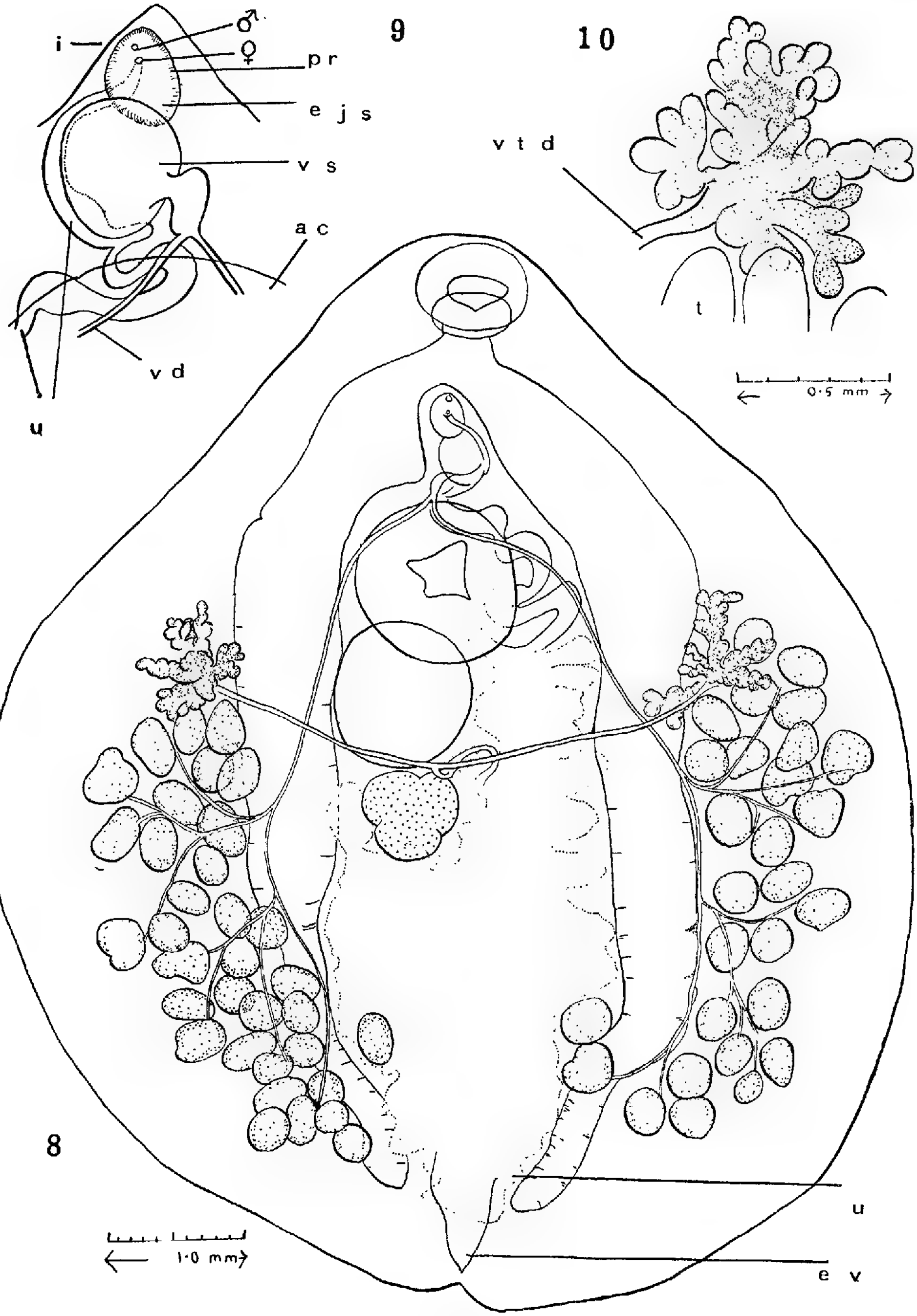
The Genus Nagmia.

Nagaty (1930, 107) characterised a new genus, *Nagmia* (type *N. yorkei)* near *Petalodistomum*, but differing from the latter in its greater size, the shape of the vitelline glands, and the greater number of testicular lobules. Nagaty's account does not include any important characters separating the two genera. Difference in size is not of generic value. Our examination of *P. polycladum* indicates that the vitellaria are of the same type. The deeper lobulation of the testes is probably not a generic character. *Nagmia* is, then, to be regarded as a synonym of *Petalodistomum*. *P. yorkei* (Nagaty) from *Trygon* sp., Ceylon, differs from *P. cymatodes* in size, the relative dimensions of the suckers, the extent of the uterine convolutions, relative sizes of receptaculum and ovary, the position and lobulation of the testes, the larger vitellarian tubes and the size of the eggs.

Probolitrema rotundatum T. H. Johnston.

A mounted flattened specimen from the collection of the late Professor S. J. Johnston and collected from an elasmobranch in Sydney, was made available through the kindness of Professor Briggs. It measures 7·8 mm. long by 6·7 mm. wide. The anterior sucker is 0·8 mm. in breadth by 0·7 in length, and the posterior 1·2 mm. in diameter, the ratio thus being 2 : 3. The body form is almost round. The pharynx measures about 0·5 mm. in width. The oesophagus is short, the wide intestinal crura are thrown into a few slight curves and the inner and outer parts of the posterior region show some small closely-set diverticula. The anterior limits of the excretory vesicle are obscured by the uterine folds. The body is minutely scaly.

There are 28 rounded or elliptical testes on one side and 34 on the other. They vary from 0·28 to 0·5 mm. in length, but most of them measure about 0·4 by 0·3 mm. The majority lie extracrurally, but a few partly underlie the crura and a vesicle is intracrural on each side posteriorly. The vasa efferentia show



Figs. 8-10.

Probolitrema rotundatum (specimen from Sydney).—8, ventral view; 9, region of sex apertures, dorsal; 10, a vitellarium, dorsal; a c, acetabulum; e j s, ejaculatory sac; e v, excretory vesicle; i, intestine; p r, prostate; t, testis; u, uterus; v d, vas deferens; v s, vesicula seminalis; v t d, vitelline duct.

that the vesicles are grouped into an anterior, middle and posterior group, though they are arranged to form a continuous field extending from the vitellarium almost to the end of the crura. Some vesicles overlie part of the yolk glands. Each vas deferens travels forwards below the intestine, then inwardly from it, beside the receptaculum on one side and between the uterus and intestine on the other side. The two vasa curve towards the midline just above the anterior edge of the acetabulum and join to form a swollen vesicula seminalis, at first thin-walled, but becoming bent and enlarged into an almost circular, more centrally placed, one. The latter communicates with the thicker-walled ejaculatory sac lying below and in front of it. This sac measures 0·3 by ·25 mm. The male pore is immediately in front of the uterine aperture and a little distance behind the intestinal bifurcation.

The ovary is slightly trilobed, ·7 mm. wide by ·7 mm. long, and just to the right of the midline. The shell gland lies in the angle formed by the receptaculum and ovary. The uterus occupies most of the intercrural region behind the receptaculum. It eventually passes forwards on the left of the latter and the acetabulum. It bends inwardly below the left vas deferens, becoming thrown into a few short folds, then passing to the left of and below the vesicula, then below the ejaculatory sac to the female pore. The receptaculum has a diameter of a millimetre. Eggs measure 0·067 to 0·07 mm. long by 0·052 to 0·055 mm. broad, each having a low rounded knob at one end.

The vitellaria lie extracrurally at the level of the receptaculum and each consists of about six long lobes, each with numerous small rounded sacculations, the whole organ appearing rather compact. The yolk ducts pass inwards and slightly posteriorly, and after travelling between the ovary and receptaculum, join near the shell gland. The common yolk duct forms a curve posteriorly before joining the oviduct as the latter narrows to enter the shell gland.

The species is tentatively assigned to *P. rotundatum* T. H. Johnston, 1934, described recently from the fiddler, *Trygonorrhina fasciata,* from Kangaroo Island. It agrees in body proportions, sucker ratio and in most anatomical details. It differs in the irregular form of the testes and the presence of more marked sacculations on both inner and outer parts of the posterior region of the intestine in *P. rotundatum.*

Another mounted specimen from S. J. Johnston's collection is 4·5 mm. by 3·7 mm. The anterior sucker has a diameter of 0·6 mm., and the acetabulum, 1·1 mm.; ovary, 0·7 mm. broad by 0·56 mm. long; receptaculum, 0·7 to 0·65; testes, 22 and 25, with the diameter ranging between 0·2 and 0·3 mm. Some posterior testes are intercrural. It belongs to the same species as the other Sydney specimen.

A few typical specimens of *P. rotundatum* were taken recently from the peritoneal cavity of a fiddler caught at Port Willunga, South Australia. The flukes were very mobile and the acetabulum very prominent in life, while the intestine showed through as a brownish-yellow structure.

The sucker ratio of this species is similar to that of *P richiardii* (Lopez, 1888), but the latter is a more elongate parasite with simple crura and with all testes extracrural, while the acetabulum is more anteriorly situated and the vitellaria are relatively more remote in relation to it. The testes are similar in form in the two species, and there are about the same number—24 and 26 being indicated in Looss' figure, but the receptaculum is much smaller and does not reach the acetabulum in the European species.

PROBOLITREMA CLELANDI T. H. Johnston.

Syn. *P. simile* Johnston.

Ofenheim's account (1900) and figure of *P. richiardii,* which Looss (1902) regarded as belonging to a distinct species and named *P. capense,* is not available.

It has the two suckers approximately equal and the acetabulum not especially projecting. The remaining anatomical characters are stated by Looss to be quite similar to those of *P. richiardii* (Lopez). It was collected from *Scyllium* sp. near Capetown.

P. clelandi from *Mustelus antarcticus*, South Australia, has a similar sucker ratio, but if Looss' statement is to be taken literally, then it differs from *P. capense* in the form and distribution of the testes, the more posterior position of the acetabulum, the form of the "head lobe," the size of the receptaculum, and the relative position of the ovary which is in front of the mid-length in *P. capense*, where as in *P. clelandi* it is just behind it and behind the level of the vitellaria.

In the original account of *P. simile* it was noted that the species was closely related to, and perhaps identical with, *P. clelandi* from the same host. The sucker ratio given was given as 14 : 17, but some specimens have the two suckers practically equal in diameter. It seems preferable to regard the two species as synonymous, in spite of the fact that the distribution of the testes is different, no vesicles being intercrural in *P. simile*, whereas some are in *P. clelandi*. The species also occurs in *Mustelus antarcticus* in Tasmanian waters.

Hosts.	Parasites.	Locality.
Dasyatis kuhli M. & H.	*Petalodistomum polycladum*	North Queensland
	Staphylorchis cymatodes	" "
Trygonorrhina fasciata M. & H.	*Probolitrema rotundatum*	Kangaroo Is. and Pt. Willunga, South Australia
Mustelus antarcticus Gunth.	*Probolitrema clelandi*	Encounter Bay, South Australia; and Tasmania
Host?	*Probolitrema rotundatum*	Sydney

Summary.

The types of *Petalodistomum polycladum* and *P. cymatodes* are re-described. *Nagmia* is a synonym of *Petalodistomum*. *Probolitrema rotundatum* is recorded from new localities and additional information supplied regarding its anatomy. *P. simile* is regarded as a synonym of *P. clelandi*.

Literature.

Baylis, H. A. 1927—Notes on three little known Trematodes. A. M. N. H. (9), 19, 426-433.

Fuhrmann, O. 1928—Trematoda in Kükenthal's Handb. Zool., 2 (2).

Johnston, S. J. 1913—On some Queensland Trematodes, etc. Q. J. M. S., 59, 361-400.

Johnston, T. H. 1934—New Trematodes from South Australian Elasmobranchs. Austr. Jour. Exp. Biol. Med. Sci., 12, 25-32.

Looss, A. 1902—Ueber neue und bekannte Trematoden aus Seeschildkröten. Zool. Jahrb. Syst., 16, 411-894.

Luehe, M. 1906—Report on the Trematode parasites from the marine fishes of Ceylon. Rep. Ceylon Pearl Oyster Fisheries, 5, 97-108.

Nagaty, H. F. 1930—A new Anaporrhutine Trematode genus and species, etc. Ann. Trop. Med. Parasit., 24, 97-108.

Southwell, T. 1913—Notes from the Bengal Fisheries Laboratory, Indian Museum, I. Rec. Ind. Mus., 9, (11), 6, 79-103.

Travassos, L. 1922—Contribuicoes, etc., xvii., Gorgoderidae brasilieras. Mem. Inst. Osw. Cruz, 15, (1), 220-234.

A REVISION OF THE IPOINAE (HOMOPTERA, EURYMELIDAE).

BY J. W. EVANS, M.A., F.R.E.S.

Summary

It has been the custom in the past to place all leaf-hoppers with the ocelli situated on the ventral surface of their heads in the Family Bythoscopidae (Superfamily Cicadelloidea). This has been done largely for convenience, since this character by itself is of little phylogenetic significance.

A REVISION OF THE IPOINAE (HOMOPTERA, EURYMELIDAE).

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Division of Entomology, Council for Scientific and Industrial Research.

[Read September 13, 1934.]

Introduction.

It has been the custom in the past to place all leaf-hoppers with the ocelli situated on the ventral surface of their heads in the Family Bythoscopidae (Superfamily Cicadelloidea). This has been done largely for convenience, since this character by itself is of little phylogenetic significance.

Three groups of leaf-hoppers are found in Australia with this character. These are *Eurymela* Le P. & S. and related genera; *Bythoscopus* Germ. and related genera; and *Idiocerus* Lewis and related genera.

In order to facilitate the classification of the first group it is proposed to give it Family rank, and the following classification is proposed for the Australian leaf-hoppers that have their ocelli ventrally placed:—

Superfamily: JASSOIDEA.

- A. Family: BYTHOSCOPIDAE.
  1. Subfamily: Bythoscopinae.
     Bythoscopus Germ., *Macropsis* Lewis, *Trocnada* Walk., *Alseis* Kirk., *Epipsychidion* Kirk., *Eurinoscopus* Kirk., *Oncopsis* Burm.
  2. Subfamily: Idiocerinae.
     Idiocerus Lewis, *Pedioscopus* Kirk.
- B. Family: EURYMELIDAE.
  - Subfamily: Eurymelinae.
  - Subfamily: Pogonoscopinae.
  - Subfamily: Ipoinae.

This paper is primarily concerned with the classification of the Ipoinae; but, in order that students in this country may be able to distinguish representatives of the Bythoscopidae from the Eurymelidae, descriptions are given at the end of the paper of two new species, one belonging to a new genus of the Bythoscopinae and the other to the genus *Idiocerus*.

In addition, a re-description is given of a species described by Jacobi in 1909 under the name of *Ipo procurrens*. This species cannot be placed in any of the known subfamilies of either the Eurymelidae or the Bythoscopidae, although it has certain Eurymeloid characters in addition to others that suggest a possible relationship with the Idiocerinae. A new genus, *Ipocerus*, has been erected to contain it, which for convenience is here grouped with the Ipoinae, until such a time as its position may be better understood.

Eurymelidae.

The Eurymelidae, unlike the Bythoscopidae, are confined to the Australian region, and, as a result of recent work by China (1926)[1] and the present author (1933),[2] have been divided into three groups, which were previously given tribal rank, but are now raised to subfamilies.

(1) China, W. E., Trans. Ent. Soc., London, 1926 (2), 289.

(2) Evans, J. W., Trans. Roy. Soc., South Austr., 57, 1933.

The Eurymelinae are wedge-shaped insects, blue, black or brown in colour, most species having white or coloured fasciae on their forewings. The sub-genital plates of the males are large and broad, and invariably have a style arising from one of their edges. All species, as far as it is known, feed on Eucalyptus trees, and they are all attended by ants.

The Pogonoscopinae are light or dark brown in colour, and frequently have white fasciae on their forewings. They differ very markedly from the other tribes owing to structural modifications brought about by their close association with ants, both the nymphs and adults actually living in ants' nests. Their legs, even in the nymphal stages, are very long, and their eyes small, both characters found in many arthropods that live in the dark. They have no spurs on their hind tibiae, and their labiums reach well past the bases of their hind legs. Like the Eurymelinae, they appear to be confined to Eucalyptus trees.

The Ipoinae comprise a number of genera more or less closely related to each other. They lack the typical Eurymeloid colour pattern, are not confined to eucalypts, are all ant attended, and, with a few exceptions, the males have no styles on the subgenital plates. In addition to those insects comprised in these three tribes, there exist a number of small species, possessing typical Eurymeloid colouration but resembling the Ipoinae in the structure of the male genitalia. Since the material at present available of these species is scanty, their description and classification is postponed.

The multiplicity of genera, paucity of species within the genera, and the wide distribution of many of the species over the continent, suggests that the Eurymelidae are a very ancient race of insects that possibly had their origin in South-Western Australia, since the Pogonoscopinae and *Ipo procurrens* of Jacobi are largely confined to this area, although the Eurymelinae and Ipoinae extend to Eastern Australia, and as far as New Guinea and New Caledonia.

Key to the Genera of the Ipoinae.

1. Hind tibia with only one distinct spur, with or without additional spines. .. 2
   Hind tibia with more than one distinct spur. 9
2. Frons produced, either into a horn, a spatulate process, or as a ledge overhanging the clypeus 3
   Frons not produced, either flat or slightly convex 5
3. Front and middle femora with short blunt spurs on their interior edges; pronotum narrow laterally, the propleuron not produced posteriorly into a toothlike process; the frons produced anteriorly into a narrow ledge that overhangs the clypeus.
   Anacornutipo, gen. nov.
   Type Eurymela lignosa Walker.

   Front and middle femora spurless; pronotum wide at the sides, the propleuron produced posteriorly into a tooth-like process; frons not produced anteriorly into a narrow ledge. 4
4. Frons produced into a spatulate process. .. .. .. Cornutipo, gen. nov.
   Type Cornutipo scalpellum, n. sp.

   Frons produced into an upward turning horn; vertex produced into two down-turned horns. .. .. Cornutipoides, gen. nov.
   Type Cornutipoides tricornis, n. sp.
5. Hind tibia with one spur and no spines; species yellowish or pale reddish-brown in colour. .. .. Anipo, gen. nov.
   Type Eurymela porriginosa Signoret.

   Hind tibia with a few or numerous spines in addition to a single spur. 6
6. Crown of head from above, broad between the eyes, not merely a narrow margin. 7
   Crown of head from above visible only as a narrow margin; tegmina largely hyaline; sub-genital plates with small apical styles. .. .. .. Ipoella, gen. nov.
   Type Ipoella fidelis, n. sp.

7. Subgenital plates broad (fig. A, figs. 6 and 7) 8
Subgenital plates narrow (fig. A, figs. 8-12) .. .. IPOIDES, gen. nov.
Type IPOIDES HACKERI, n. sp.

8. Small species resembling *Ipo* Kirk. in shape and colouration, the tegmina steeply tectiform .. .. STENIPO, gen. nov.
Type STENIPO SWANI, n. sp.
Species not resembling *Ipo* Kirk. in shape or colouration; tegmina not steeply tectiform. .. .. CITRIPO, gen. nov.
Type CITRIPO FLANDERSI, n. sp.

9. Hind tibia with two spurs and numerous spines. 10
Hind tibia with three spurs and numerous spines. 11

10. Tegmina broad, hyaline or hyaline with black and white areas; appendix continuing broadly round the apex of the tegmen; subgenital plates broad, the parameres reaching to the apices of the plates. .. .. IPO Kirkaldy
Type IPO PELLUCIDA, F
Tegmina narrow; appendix continuing narrowly round the apex of the tegmen; subgenital plates narrow, the parameres not more than half the length of the plates.
KATIPO, gen. nov.
Type EURYMELOIDES RUBRIVENOSUS, Kirk.

11. Hind tibia with one large spur on one of the inner edges of the tibia, and two slightly smaller ones on the other edge; head broader than long; subgenital plates with small styles. .. .. PAURIPO, gen. nov.
Type PAURIPO INSULARIS, n. sp.
Hind tibia with three spurs decreasing in size from the apex of the tibia to the base, all on the same edge of the tibia; head almost as long as broad; subgenital plates without styles. .. .. OPIO, gen. nov.
Type BYTHOSCOPUS MULTISTRIGIA Walker.

The above key is an artificial one and does not group the genera into any natural order. They can, however, be separated into four distinct tribes:—The Ipoini, comprising *Ipo, Stenipo* and *Ipoides;* the Anipoini, comprising *Anipo, Katipo, Citripo* and *Ipoella;* the Cornutipoini, comprising *Cornutipo, Cornutipoides* and *Anacornutipo;* and finally the Opioni, containing the isolated genus *Opio.*

The colour patterns of the majority of the species comprised in the Eurymelidae are extremely variable, and descriptions largely based on a detailed account of the colouration of a few individuals are of little value. The characters afforded by the male genitalia are valuable for both specific and generic determination, and accordingly figures are given for every species described in this paper.

Ipoini. IPO Kirkaldy.

H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 464, 1906.

Wedge-shaped insects, the tegmina steeply tectiform apically; head much broader than long, slightly rounded, maxillary plates broad, antennal pits shallow, eyes prominent, the labium just reaching to the base of the hind legs, the crown of the head from above only visible laterally against the eyes; tegmina broad, the appendix narrow, continuing round the apex of the tegmen to the costal margin; hind tibia with two spurs and numerous strong spines; male genitalia with large flat-subgenital plates and long parameres, the aedeagus with a strong armature of spines at the apex and without an anterior ventral process.

Species comprised in this genus are apparently confined to the tropical regions of the continent.

IPO PELLUCIDA F. (Fig. A, fig. 15.) (Genotype.)

Cicada pellucida Fabricius. Entom. Syst. 4; 41, 60, 1794. *Ipo ambita* Kirkaldy, H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 464, 1906. *Ipo aegrota* Kirkaldy, H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 464, 1906.

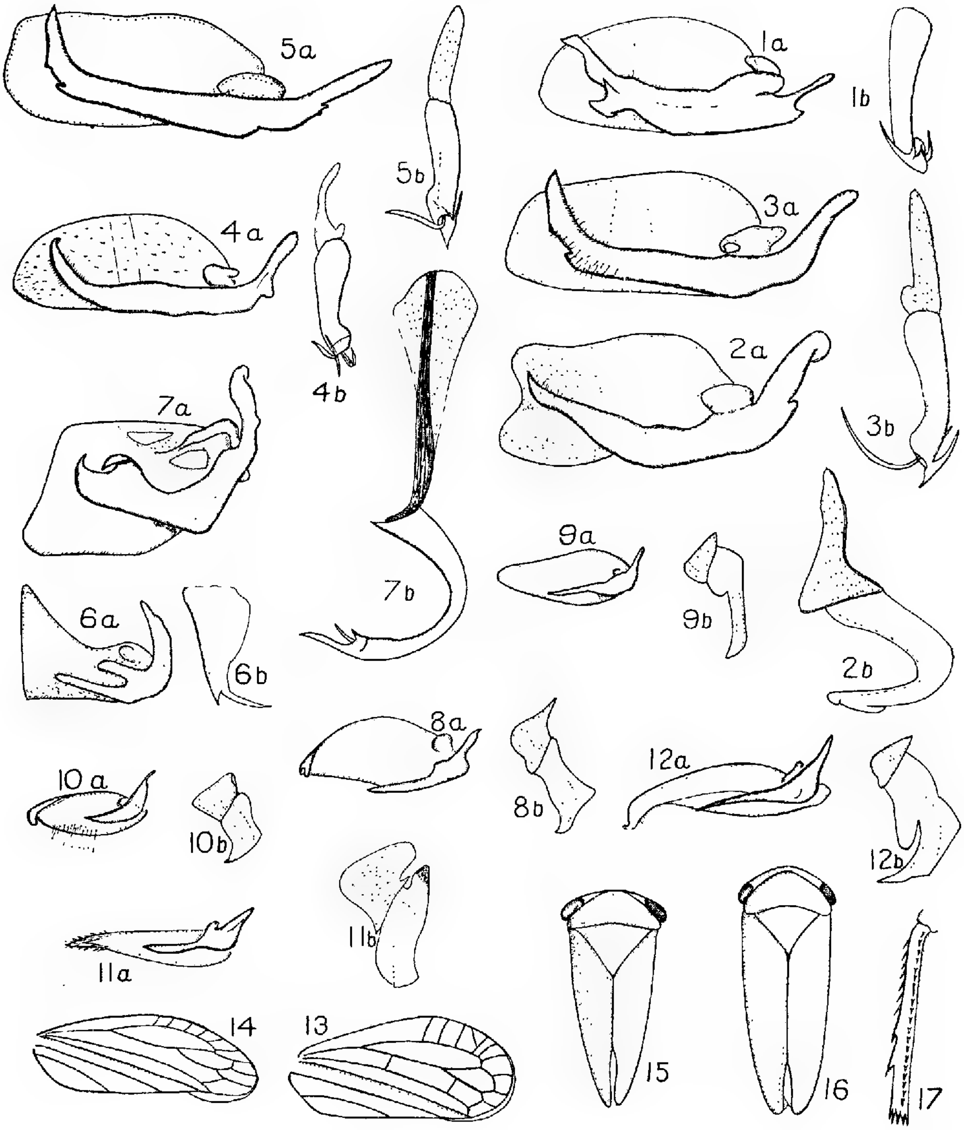

Fig. A.

Figure 1a .. *Ipo pellucida*, subgenital plate and paramere.
" 1b .. " " aedeagus.
" 2a .. *Ipo conferta*, subgenital plate and paramere.
" 2b .. " " aedeagus.
" 3a .. *Ipo honiala*, subgenital plate and paramere.
" 3b .. " " aedeagus.
" 4a .. *Ipo hilli*, subgenital plate and paramere.
" 4b .. " " aedeagus.
" 5a .. *Ipo sordida*, subgenital plate and paramere.
" 5b .. " " aedeagus.
" 6a .. *Stenipo swani*, subgenital plate and paramere.
" 6b .. " " aedeagus.

(Continued on opposite page)

Description.—Length, ♂, 6-7 mm.; ♀, 8-9 mm. (from the apex of the head to the tip of the folded tegmina). Head, width between the eyes 3-4 mm., chestnut brown suffused to a varying extent with dark brown. Pronotum, pale or dark brown, with or without a median longitudinal white stripe. Scutellum, smooth, pale or deep chestnut brown. Tegmen, entirely hyaline or transparent, or hyaline or transparent but for a broad anterior hyaline white fascia; anterior costal and claval area punctate; veins dark brown or black with white bars. The tegmen may be mottled with dark brown to a varying extent. Thorax, ventrally pale brown. Legs, femora pale brown, tibiae and tarsi dark brown or black, but for the first tarsal segment of the hind legs, which is white. Abdomen, ventral surface, pale brown. Male genitalia, as in fig. A, figs. 1a and 1b. Parameres bifurcate and extending beyond the apices of the subgenital plates. Aedeagus straight, bearing a strong armature of spines at the apex.

Distribution.[3]—Queensland and Northern Australia.

IPO CONFERTA Kirkaldy.

Ipo conferta Kirk., H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 465; 1906. *Ipo pompais* Kirk., H.S.P.A. Exp. Sta. Rec. Bull. 3; 35, 1907.

Description.—Length, 5-7·5 mm. Head, width, 3 mm., punctate; pale yellowish-brown, mottled with dark brown or black, maxillary plates and lorae pale, eyes reddish-brown, not as prominent as in other species in this genus. Pronotum, narrow, punctate, ochreous mottled with dark brown or black. Scutellum, ochreous brown or black with a few pale yellow markings. Tegmen, pale yellowish-hyaline, sparsely mottled with dark brown or black; veins, white or black; an indistinct white hyaline anterior fascia, widest against the costal margin of the tegmen, or tegmen almost entirely suffused with black, except for yellow mottlings on the clavus and an anterior irregular opaque white fascia, not transverse, and a hyaline area against the distal costal margin, which is mottled with black; tegmen, narrow apically. Thorax, ventral surface, pale yellowish-brown. Legs, coxae and proximal two-thirds of the femora pale brown, the rest marked with a pattern of black and brown. Abdomen, ventral surface, pale yellowish-brown. Male genitalia, as in fig. A, figs. 2a and 2b. The distal halves of the ventral edges of the subgenital plates are thickened, the parameres simple, not bifurcate, and the aedeagus curved, not straight

Distribution.—Queensland.

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(3) Distribution records refer to specimens actually examined, and do not necessarily indicate the limits of any species.

Fig. A (continued).

Figure 7a	..	*Stenipo bifurcata*, subgenital plate and paramere.
,, 7b	..	,, ,, aedeagus.
,, 8a	..	*Ipoides hackeri*, subgenital plate and paramere.
,, 8b	..	,, ,, aedeagus.
,, 9a	..	*Ipoides leai*, subgenital plate and paramere.
,, 9b	..	,, ,, aedeagus.
,, 10a	..	*Ipoides translucens*, subgenital plate and paramere.
,, 10b	..	,, ,, aedeagus.
,, 11a	..	*Ipoides ooldeae*, subgenital plate and paramere.
,, 11b	..	,, ,, aedeagus.
,, 12a	..	*Ipoides casurinae*, subgenital plate and paramere.
,, 12b	..	,, ,, aedeagus.
,, 13	..	*Ipo hilli*, tegmen.
,, 14	..	*Ipoides casurinae*, tegmen.
,, 15	..	*Ipo pellucida*.
,, 16	..	*Ipoides hackeri*.
,, 17	..	*Ipo hilli*, hind tibia.

Ipo honiala Kirkaldy.

Ipo honiala Kirk., H.S.P.A. Exp. Sta. Rec. Bull. 1 (9); 465, 1906.

Description.—Length, 5-6 mm. Head, width, 3 mm.; crown and vertex pale yellowish-brown suffused with dark brown, the rest of the head pale yellowish or reddish-brown. Pronotum, punctate, grey, mottled with dark brown or black. Scutellum, smooth, black or dark brown, the posterior angle yellow. Tegmen, dark brown or black, an indistinct anterior transverse white or hyaline fascia, the apical third of the tegmen hyaline, and there may be other small hyaline areas scattered over the tegmen; veins brown or black. Thorax, ventral surface dark brown or black. Legs, brown or black. Abdomen, ventral surface, pale yellowish-brown. Male genitalia, as in fig. A, figs. 3a and 3b. The aedeagus straight, one of the apical spines very long and curved.

Distribution.—Queensland.

Ipo hilli, n. sp.

Description.—Length, ♂, 5 mm., ♀, 7 mm. Head, width, 3 mm., light or dark brown mottled with buff; maxillary plates and lorae largely pale brown, the rest of the head mostly dark brown. The whole surface of the head is covered with short hairs. Pronotum, grey mottled with dark brown, and with a broad median longitudinal grey stripe, also hairy. Scutellum, light or dark brown, the posterior margin yellow. Tegmen, anterior claval and costal areas punctate; the anterior two-thirds of the tegmen deep chocolate brown with brown veins, the posterior third transparent with white veins. There is an anterior transverse fascia divided into two areas, one in the costal and one in the claval area, the latter lying along the margin of the scutellum. There are a few small round and narrow longitudinal hyaline areas on the dark part of the tegmen (fig. A, fig. 13). Thorax and abdomen, ventral surface, pale brown. Legs, proximal halves of the femora pale brown, distal halves dark brown; tibiae dark brown with white oval spots, and one or more of the edges of the hind tibiae may be white (fig. A, fig. 17). Male genitalia, as in fig. A, figs. 4a and 4b.

Distribution.—Northern Australia.

Type ♂, from Darwin (coll. G. F. Hill), paratype ♀, both specimens in the collection of the South Australian Museum.

Ipo sordida, n. sp.

Description.—Length, 5 mm. Head, width 2·5 mm.; pale chestnut brown and very dark brown or black, the areas covered by the two colours varying in extent. The head is covered with fine short hairs. Pronotum, grey, densely mottled with dull brown. Scutellum, chestnut brown or very dark brown. Tegmen, largely hyaline, the anterior costal and claval areas punctate; an indistinct broad anterior transverse whitish fascia, veins brown. The whole tegmen is mottled with dull brown, especially in the neighbourhood of the veins, which are faintly and irregularly barred with white. Thorax, ventral surface dark brown. Legs, femora very dark brown with pale areas; tibiae, pale brown. Abdomen, ventral surface, pale brown. Male genitalia as in fig. A, figs. 5a and 5b. Similar in shape to those of *I. honiala*, the recurved spine at the apex of the aedeagus being smaller in this species.

Distribution.—Thursday Island, Queensland.

Type, ♂, from Thursday Island (coll. A. M. Lea); paratypes, 1 ♂ and 1 ♀; all three specimens in the collection of the South Australian Museum.

Ipo torpens Jacobi.

Ipo torpens Jacobi, Faun. Südwest-Austral., Ergeb. d. Hamburg S. Austral. Forschungsreise 1905, Michaelsen u. Hartmeyer, ii., 20; 341, 1909.

This species, from Mongers Lake, near Subiaco, Western Australia, is unknown to me. Although impossible to place in any genus from the description alone, it is probable that it belongs either to the genus *Ipoides* or *Stenipo,* rather than to *Ipo,* since the length is given by Jacobi as 4·5 mm., also no representatives of the genus *Ipo* have been recorded from Western Australia.

Stenipo, gen. nov.

This genus is very closely related to *Ipo* Kirk., the species comprised in it being smaller, and differing from those in the previous genus in the following characters:—The vertex of the head is broadly visible from above and is as wide in the middle as against the eyes, the tegmina are narrow and the hind tibiae have only one spur in addition to numerous spines.

Stenipo swani, n. sp. (Genotype.)

Description.—Length, 4 mm. Head, width, 2 mm., yellowish-grey suffused with dark brown, in some specimens the frons is pinkish. Pronotum, greyish sparsely mottled with dark brown. There is a broad grey longitudinal median stripe and two brown oval areas lying against the anterior margin. Scutellum, greyish mottled with pale and dark brown. Tegmen, hyaline, the anterior costal and claval areas punctate; there may be a narrow anterior and a broad posterior transverse white fascia, or the tegmen may be almost entirely yellowish-hyaline or opaque; veins black with white bars. Thorax, ventral surface, very dark brown. Legs, pale brown. Abdomen, ventral surface, very pale brown. Male genitalia, as in fig. A, figs. 6a and 6b. Subgenital plates more or less triangular in shape; parameres deeply bifurcate; aedeagus boot-shaped. Host plant, Melaleuca sp.

Distribution.—Rottnest Island, Western Australia.

Type ♂, from Rottnest Island (coll. D. C. Swan, 1/31), in the collection of the C.S.I.R. Division of Entomology at Canberra. Described from a long series of males and females.

Stenipo bifurcata, n. sp.

Description.—Length, 5 mm. Head, 2 mm. wide; the anterior half pale yellowish-brown, the posterior brown, densely mottled with very dark brown and black. Pronotum, greyish, mottled with dark brown; an indistinct broad grey median longitudinal stripe, and two pale brown oval areas lying against the anterior margin. Scutellum, dark brown and grey, the anterior corners chestnut brown. Tegmen, proximal half whitish-opaque, the distal half yellowish-hyaline; anterior costal and claval areas punctate; veins brown with white bars. Thorax, ventral surface dark brown. Legs, pale brown. Abdomen, ventral surface, pale brown. Male genitalia, as in fig. A, figs. 7a and 7b. Subgenital plates wide; aedeagus strongly curved.

Distribution.—South Australia.

Type ♂, paratype ♀, both specimens from Corney Point, South Australia, and both in the collection of the South Australian Museum.

Ipoides, gen. nov.

This genus is closely related to *Stenipo.* The crown is visible dorsally as a broad border, slightly wider against the eyes than in the middle. Tegmina narrow, the appendix big. Hind tibia with one spur and a few small spines. Male genitalia with narrow subgenital plates, short parameres, and the aedeagus without apical spines.

Ipoides hackeri, n. sp. (Genotype.) (Fig. A, fig. 1b.)

Description.—Length, 4 mm. Head, width, 2 m.m,, marked with an irregular pattern of yellow and dark brown, the maxillary plates usually pale, the vertex dark brown and the posterior margin of the crown dull greyish-yellow. Pronotum and scutellum, dull grey mottled with dark brown. Tegmen, transparent, veins pale brown with white bars; some specimens have a trace of a narrow anterior fascia; appendix not continuing round the apex of the tegmen. Thorax, ventral surface dark brown. Legs, pale yellowish-brown. Abdomen, ventral surface pale brown. Male genitalia as in fig. A, figs. 8a and 8b. Subgenital plates recurved at apices, parameres short, aedeagus simple, with no spines or processes.

Distribution.—Queensland.

Type, ♂, from Brisbane (coll. H. Hacker), in the collection of the South Australian Museum. Described from a long series of both sexes.

Ipoides leai, n. sp.

Description.—Length, 4 mm. Head, width, 1·5 mm., ochreous marked with an irregular pattern of dark brown and black. Pronotum, greyish and ochreous mottled with dark brown. Scutellum, dark brown or black with an imperfectly rounded pale area. Tegmen, yellowish-hyaline; an irregular whitish anterior fascia stretching diagonally across the tegmen from near the centre of the costal margin to the apex of the scutellum; veins dark brown barred with white; appendix not continuing round the apex of the tegmen. Thorax, ventral surface dark brown. Legs marked with a variable pattern of light and dark brown. Abdomen, ventral surface, pale brown. Male genitalia, as in fig. A, figs. 9a and 9b. Aedeagus with a very slight anterior ventral process.

Distribution.—New Caledonia.

Type, ♂ from Noumea (coll. A. M. Lea), paratypes 2 ♂'s and 1 ♀; type and paratypes in the collection of the South Australian Museum.

Ipoides translucens, n. sp.

Description.—Length, 4 mm. Head, width 1·7 mm., greyish-buff but for the maxillary plates and lorae which are evenly mottled with dark brown and yellow. Pronotum and scutellum, grey mottled with dark brown. Tegmen, transparent, with two brown spots against the hind margin of the clavus; veins pale brown with white bars; appendix continuing narrowly round the apex of the tegmen. Thorax, ventral surface black. Legs, proximal two-thirds of femora black, distal two-thirds yellowish; tibiae yellowish, the apices of the hind tibiae black. Abdomen ventral surface pale brown. Male genitalia, as in fig. A, figs. 10a and 10 b. Subgenital plates recurved at apices; aedeagus simple.

Distribution.—Queensland.

Type, ♂ from Townsville (coll. F. P. Dodd), paratype ♀, both specimens in the collection of the South Australian Museum.

Ipoides ooldeae, n. sp.

Description.—Length, 5 mm. Head, width, 2·2 mm.; crown from above wider against the eyes than in the centre; head pale yellowish-brown with a few scattered brown spots; eyes and ocelli black, frons distinctly convex (more so than in other species in this genus). Pronotum and scutellum, either entirely greyish-yellow or greyish-yellow mottled with brown or dark brown. Tegmen, transparent; veins brown with white bars; appendix continued very narrowly round the apex of the tegmen. Thorax, ventral surface pale yellowish-brown. Legs, pale yellowish-brown streaked with dark brown. Abdomen, ventral sur-

face, pale yellowish-brown. Male genitalia, as in fig. A, figs. 11a and 11b. Subgenital plates very narrow apically, aedeagus with a posterior dorsal thickening.

Distribution.—Ooldea, South Australia.

Type, ♂ from Ooldea (coll. A. M. Lea), paratypes 1 ♂, 4 ♀'s; type and paratypes in the collection of the South Australian Museum.

Ipoides casurinae, n. sp.

Description.—Length, 5 mm. Head, width, 2 mm., pale yellow mottled with a distinct though variable pattern of light and dark brown, the maxillary plates and lorae invariably pale yellow. Crown from above wider against the eyes than in the centre. Pronotum and scutellum, yellowish-grey mottled with dark brown. There is an indistinct median pale longitudinal stripe on the pronotum. Tegmen (fig. A, fig. 14), hyaline, or with a narrow curved anterior white fascia, which may be only partially developed; veins dark brown with white bars; appendix continuing narrowly round the apex of the tegmen. Thorax, ventral surface dark brown. Legs, pale brown. Abdomen, ventral surface pale brown. Male genitalia as in fig. A, figs. 12a and 12b. The subgenital plates are narrow and the aedeagus has an anterior ventral process, but the genitalia resemble those of the genotype in the apical curvature of the subgenital plates, and in the boot-shaped aedeagus. Host plant, *Casuarina,* spp.

Distribution.—Queensland, New South Wales and Western Australia.

Type, ♂ from Canberra, F. C. T. (coll. J. W. E.), in the collection of the C.S.I.R. Division of Entomology at Canberra, described from a long series of males and females.

NOTE.—The above species so closely resembles the other species comprised in the genus *Ipoides,* that it is included in this genus, in spite of the fact that the male genitalia do not resemble very closely those of the genotype.

Anipoini. **Ipoella,** gen. nov.

This genus differs from the preceding ones in the following characters:—The labium only reaches to between the middle pair of legs; the head is only visible from above as a very narrow edge in the centre, though slightly wider against the eyes; the anterior margin of the pronotum is at a much lower level than the posterior margin; the tegmina have numerous costal cells; the hind tibiae have a few small spines in addition to one large spur; the subgenital plates in the male are broader, and the aedeagus is differently shaped.

Ipoella fidelis, n. sp. (Genotype.)

Description.—Length, 6 mm. Head, width, 2·5 mm., greyish-yellow with a dark brown T-shaped area, stretching from the base of the clypeus to a little above the dorsal margin of the frons, and extending laterally to the eyes. Pronotum, grey, mottled with dark brown. Scutellum, yellowish-brown. Tegmen, hyaline, irregularly mottled with dull brown; veins brown with white bars. Thorax, ventral surface black. Legs, pale brown streaked with dark brown. Abdomen, ventral surface pale brown. Male genitalia, as in fig. B, figs. 1a and 1b. Subgenital plates broad with a small spine attached to the apical finger-like process; parameres short and broad.

Distribution.—Bunya Mountains, Queensland.

Type, ♂ from the Bunya Mountains (coll. H. Hacker); paratypes 1 ♂ and 1 ♀. Type and paratypes in the collection of the South Australian Museum.

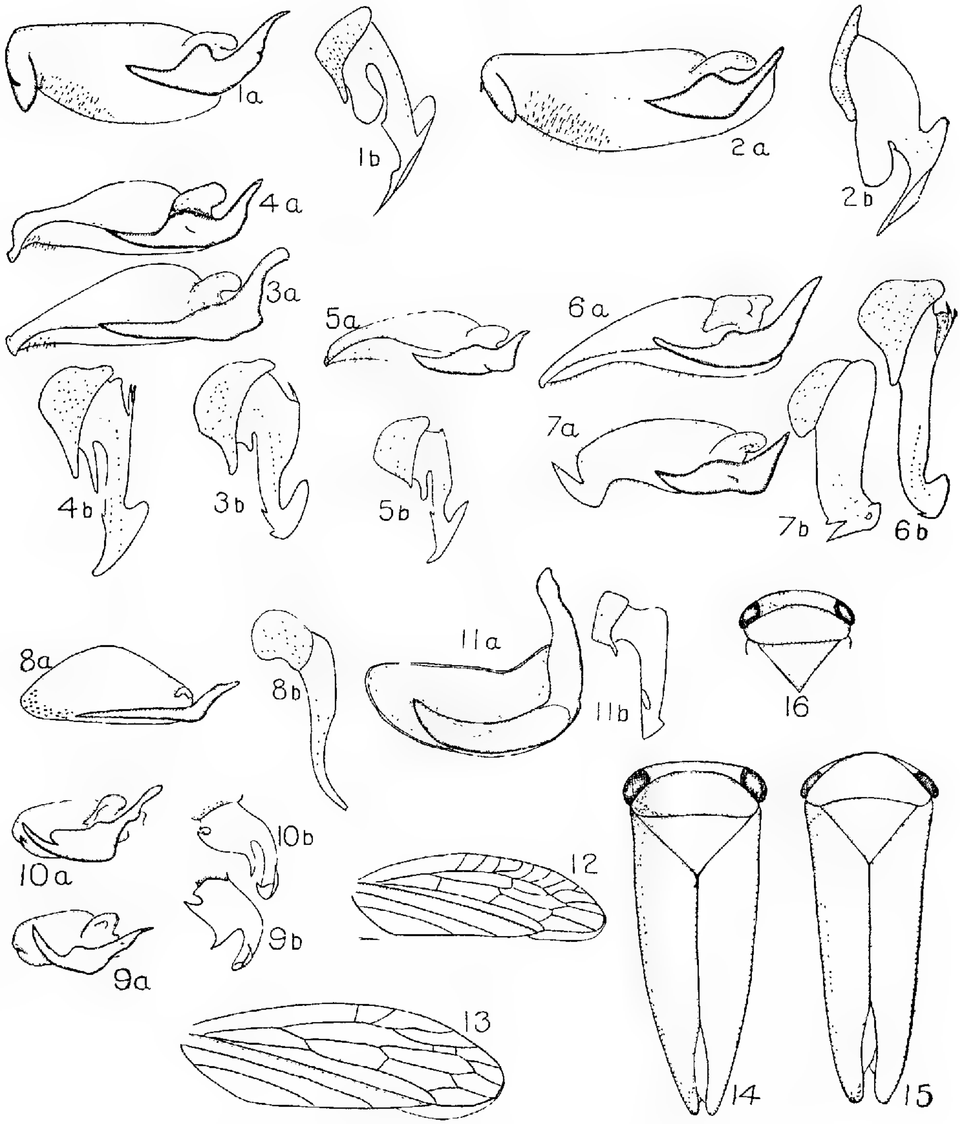

Fig. B.

Figure	1a	..	*Ipoella fidelis*, subgenital plate and paramere.
„	1b	..	„ „ aedeagus.
„	2a	..	*Ipoella canberrensis*, subgenital plate and paramere.
„	2b	..	„ „ aedeagus.
„	3a	..	*Anipo porriginosa*, subgenital plate and paramere.
„	3b	..	„ „ aedeagus.
„	4a	..	*Anipo brunneus*, subgenital plate and paramere.
„	4b	..	„ „ aedeagus.
„	5a	..	*Anipo unimaculata*, subgenital plate and paramere.
„	5b	..	„ „ aedeagus.
„	6a	..	*Katipo rubrivenosa*, subgenital plate and paramere.
„	6b	..	„ „ aedeagus.
„	7a	..	*Katipo signoreti*, subgenital plate and paramere.
„	7b	..	„ „ aedeagus.

(Continued on opposite page)

Ipoella canberrensis, n. sp.

Description.—Length, 7 mm. Head, width, 2·5 mm., pale yellow with a large dark T-shaped mark; crown, grey mottled with brown. Pronotum, greyish-brown mottled with black. Scutellum, yellowish-brown mottled with black. Tegmen, hyaline, largely suffused with dark brown, with an indistinct anterior transverse hyaline fascia. Thorax, ventral surface black. Legs, femora pale brown, tibiae streaked with pale and dark brown. Abdomen, ventral surface dark brown. Male genitalia as in fig. B, figs. 2a and 2b. Host plant, *Eucalyptus* spp.

Distribution.—Federal Capital Territory.

Type, ♂ from Canberra (coll. J. W. E.), in the collection of the C.S.I.R. Division of Entomology at Canberra.

Ipoella insignis Distant.

Eurymeloides insignis Dist., Ann. Soc. Ent. Belg. 52; 103, 1908.

It is very probable that this species belongs to this genus, but since the type specimen is a female, this point cannot be definitely settled until more material is available for study. The description given below is of the type specimen.

Description.—Length, 7 mm. Head, width, 2·5 mm., yellowish-brown, the maxillary plates whitish. Pronotum, pale yellowish-brown. Scutellum, pale chestnut-brown. Tegmen, chocolate-brown, with two transverse fasciae, the anterior white and opaque, the posterior transparent and widest at the costal margin of the tegmen; clavus, pale yellowish-brown. Thorax and abdomen, ventral surface, pale yellowish-brown. Legs, femora, pale yellowish-brown; tibiae marked with an irregular pattern of yellow and brown; tarsi dark brown, but for the first tarsal segment of the hind tibiae, which are white.

Type, ♀ from Queensland, in the collection of the British Museum.

Anipo, gen. nov.

This genus differs from the preceeding one, to which it is closely related, principally in the structure of the male genitalia. The hind tibiae have one spur and no additional spines.

Anipo porriginosa Signoret. (Genotype.)

Eurymela porriginosa Sign., Ann. Soc. Ent. Fr. (2) viii.; 51, 1850.

Bythoscopus luridus Walker, List Homopt. iii.; 870, 1851.

Description.—Lengh, 7 mm. Head, width, 2·6 mm., pale yellowish-brown. Pronotum, reddish-brown mottled with grey. Scutellum, chestnut-brown. Tegmen, hyaline, veins pinkish. The tegmen may be dotted with white spots or have

Fig. B (continued).

Figure 8a	..	*Citripo flandersi,* subgenital plate and paramere.
„ 8b	..	„ „ aedeagus.
„ 9a	..	*Pauripo insularis,* subgenital plate and paramere.
„ 9b	..	„ „ aedeagus.
„ 10a	..	*Pauripo continentalis,* subgenital plate and paramere.
„ 10b	..	„ „ aedeagus.
„ 11a	..	*Opio multistrigia,* subgenital plate and paramere.
„ 11b	..	„ „ aedeagus.
„ 12	..	*Anipo porriginosa,* tegmen.
„ 13	..	*Opio multistrigia,* tegmen.
„ 14	..	*Opio multistrigia.*
„ 15	..	*Anipo brunneus.*
„ 16	..	*Citripo flandersi,* dorsal surface of head and thorax.

an anterior white fascia varying in shape (fig. B, fig. 12). Thorax and abdomen, ventral surface pale yellowish-brown. Legs, pale brown. Male genitalia, as in fig. B, figs. 3a and 3b. Subgenital plates narrower and the parameres longer than with the previous genus; aedeagus with anterior dorsal spines in addition to a posterior ventral flap. Host plant, *Eucalyptus* spp.

Distribution.—Queensland, New South Wales and South Australia.

Anipo brunneus, n. sp. (Fig. B, fig. 15.)

Description.—Length, 5 mm. Head, width, 2·2 mm., yellowish-brown, eyes red. Pronotum, yellowish-brown spotted with white. Scutellum, yellowish-brown. Tegmen, hyaline, greenish-yellow in colour. Thorax and abdomen, ventral surface, very pale yellowish-brown. Legs, yellowish-brown. Male genitalia, as in fig. B, figs. 4a and 4b. Very similar to those of the genotype. Host plant, *Eucalyptus* spp.

Distribution.—New South Wales.

Type, ♂ from Canberra F.C.T. (coll. A. L. Tonnoir), in the collection of the C.S.I.R. Division of Entomology at Canberra, described from a long series of males and females.

Anipo unimaculata, n. sp.

Description.—Length, 5 mm. Head, width, 2·2 mm., yellowish-brown, vertex and crown chestnut brown, eyes red. Pronotum, deep chocolate-brown, the posterior margin whitish. Scutellum, pale brown. Tegmen, pale yellowish-hyaline but for an area between the radius and the costa, not extending as far as where the median vein leaves the radius, which is very dark brown or black. Thorax, ventral surface, very dark brown or black and yellowish. Legs, yellowish, excepting the distal three-quarters of the hind femora and the proximal halves of the hind tibiae, which are dark brown. Abdomen, ventral surface, very pale yellowish-brown. Male genitalia, as in fig. B, figs. 5a and 5b. Very similar to those of the genotype.

Distribution.—Queensland.

Type, ♂ from Brisbane (coll. H. Hacker), paratypes 1 ♂ and 2 ♀'s. Type and paratypes in the collection of the South Australian Museum.

Katipo, gen. nov.

This genus can be distinguished from the two previous ones, to which it is closely related by the character of the hind tibiae, which bear two distinct spurs in addition to numerous spines.

KATIPO RUBRIVENOSA Kirkaldy.

Eurymeloides rubrivenosus Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 353, 1906.

Eurymeloides lentiginosus Kirk., H.S.P.A. Exp. Sta. Bull. 1 (9); 353, 1906.

Description.—Length, 5 mm. Head, width, 2·3 mm., black or brown with yellow spots, the maxillary plates and the external margins of the frons and lorae, yellowish. Pronotum, black or brown with cream coloured spots, the anterior lateral angles brownish. Scutellum, brown. Tegmen, claval and proximal area brown, the rest black with several round transparent areas, and a large area against the distal costal margin, usually transparent; veins pink; there may be an indistinct narrow white median transverse fascia, seldom extending into the clavus. Thorax, ventral surface, black or yellow. Legs, entirely black, entirely brown, or black and brown. Abdomen, ventral surface pale brown or black. Male genitalia, as in fig, B, figs. 6a and 6b. Similar to those of *Anipo* spp.; the aedeagus without an anterior ventral process. Host plant, *Eucalyptus* spp.

Distribution.—Queensland, New South Wales and South Australia.

Katipo signoreti, n. sp.

Description.—Length, 5 mm. Head, width, 2·2 mm., yellowish-brown; with or without a median black longitudinal stripe stretching from the base of the clypeus to the dorsal margin of the frons; crown and vertex black, spotted with cream and white. Pronotum, grey mottled with black, or pale brown. Scutellum, coloured with a variable pattern of brown and black, or entirely brown. Tegmen, hyaline, suffused with pale brown and dotted with numerous round transparent and whitish spots. Thorax, legs and abdomen, yellow and black, or entirely yellowish. Male genitalia, as in fig. B, figs. 7a and 7b. Subgenital plates with an apical hook-like process, aedeagus without any posterior dorsal spines. Host plant, *Eucalyptus* spp.

Distribution.—New South Wales.

Type, ♂ from Canberra, F.C.T. (coll. J. W. E.), in the collection of the C.S.I.R. Division of Entomology at Canberra.

Citripo, gen. nov.

This genus differs from the preceding ones in being less narrowly wedge-shaped. The head is visible from above as a broad even band. The tegmen has only a few (1-5) costal cells. The hind tibia has only one spur in addition to numerous strong spines, and the male genitalia are differently shaped.

Citripo flandersi, n. sp.

Description.—Length, 5 mm. Head (fig. B, fig. 16), width, 2·3 mm., black, the frons, crown and vertex mottled with yellow, the rest of the head is similarly coloured, but the black areas are less dense; eyes black. Pronotum and scutellum, yellowish-grey mottled with black. Tegmen, hyaline, densely mottled with dull brown; an anterior opaque somewhat rounded fascia, surrounded by an opaque black area. Thorax and abdomen, ventral surface, black. Legs, blackish-brown with white spots. Male genitalia as in fig. B, figs. 8a and 8b. Parameres long and narrow, aedeagus simple. Host plant, *Eremocitrus glauca* (Native Lime).

Distribution.—Queensland.

Type, ♂ from Queensland (coll. S. Flanders), in the collection of the C.S.I.R. Division of Entomology at Canberra.

Pauripo, gen. nov.

This genus contains two small squat species, which differ from each other principally in the characters of the male genitalia. Head, broad, the frons more or less hexagonal; maxillary plates broad; only a narrow border of the crown visible dorsally. Pronotum narrow. Tegmina tectiform apically, appendix continuing narrowly round the apex. Hind tibia with a large spur on one of the inner edges and two somewhat smaller ones on the other. Male genitalia with small styles on the ventral edges of the small subgenital plates.

Note.—This genus is included in the Ipoinae on account of its general resemblance to insects in the preceding genera, although the development of a style on the subgenital plates suggests relationships with the Eurymelinae.

Pauripo insularis, n. sp. (Genotype.)

Description.—Length, 4 mm. Head, width, 1·5 mm., chestnut-brown suffused to a varying extent with very dark brown or black, the maxillary plates and lorae frequently paler than the rest of the head. Pronotum, greyish-brown mottled with dark brown. Scutellum, black. Pronotum, hyaline, mottled with dull brown, especially in the claval area; veins brown or pink. The tegmina may

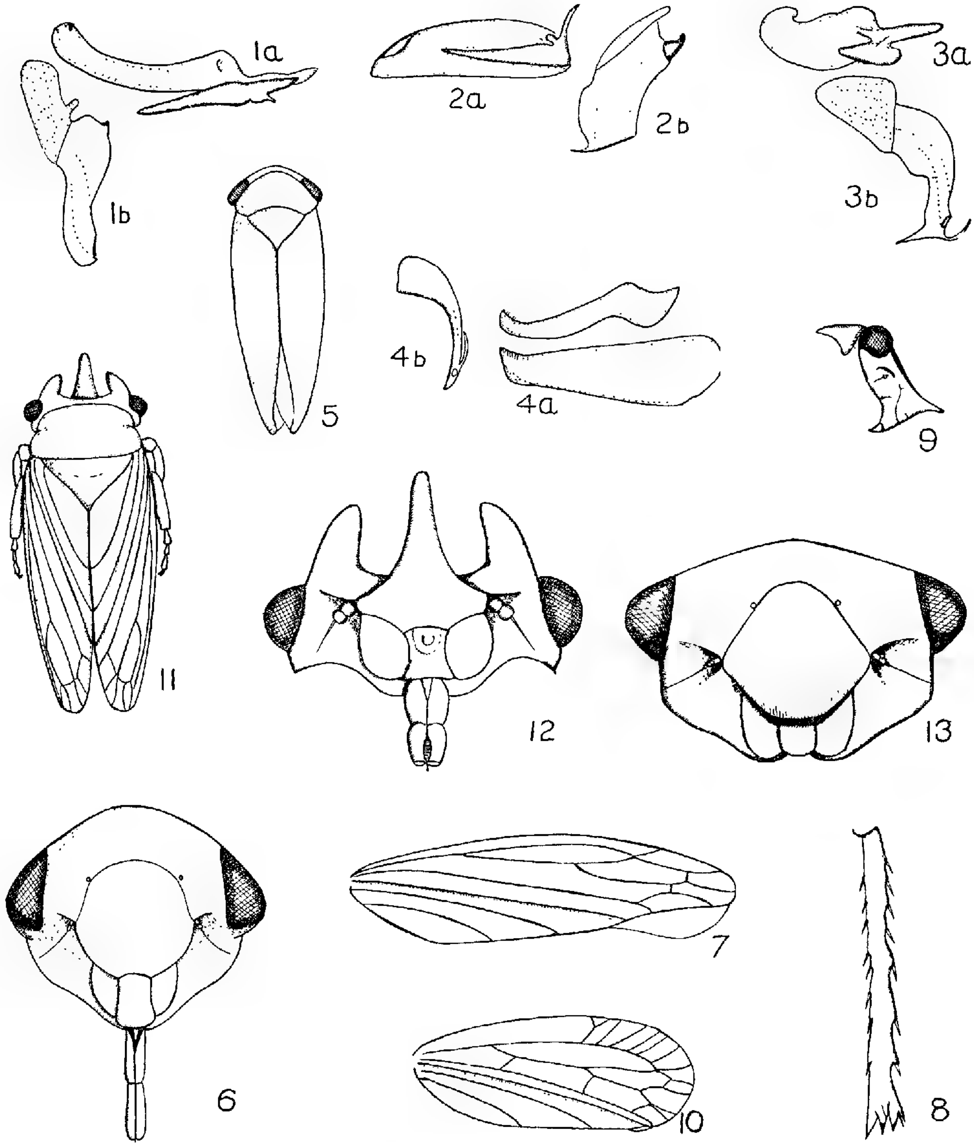

Fig. C.

Figure 1a .. *Cornutipo scalpellum,* subgenital plate and paramere.
„ 1b .. „ „ aedeagus.
„ 2a .. *Anacornutipo lignosa,* subgenital plate and paramere.
„ 2b .. „ „ aedeagus.
„ 3a .. *Cornutipoides tricornis,* subgenital plate and paramere.
„ 3b .. „ „ aedeagus.
„ 4a .. *Ipocerus procurrens,* subgenital plate and paramere.
„ 4b .. „ „ aedeagus.
„ 5 .. *Ipocerus procurrens.*
„ 6 .. *Ipocerus procurrens,* head.
„ 7 .. „ „ tegmen.
„ 8 .. „ „ hind tibia.

(Continued on opposite page)

be entirely hyaline but for the claval area, and in some specimens there are traces of narrow anterior and posterior transverse fasciae. Thorax, ventral surface, pale biscuit colour, suffused to a varying extent with black. Legs, femora, pale yellowish-brown; tibiae with a number of distinct oval white spots, the external edges of the hind tibiae may be dark brown. Abdomen, ventral surface, pale yellowish-brown. Male genitalia, as in fig. B, figs. 9a and 9b. Subgenital plates more or less rectangular with small styles at the apex of the ventral margin; aedeagus with apical spines and an anterior ventral process.

Distribution.—Kangaroo Island, South Australia.

Type, ♂ from Vivonne Bay, Kangaroo Island, paratypes 1 ♂ and 2 ♀'s. Type and paratypes in the collection of the South Australian Museum.

Pauripo continentalis, n. sp.

Description.—Length, 4 mm. Head, width, 1·5 mm., chestnut brown. In some specimens the frons and vertex are black. Pronotum, chestnut, or very dark brown, mottled with black. Scutellum, black. Tegmen, dull brown with irregular hyaline areas, these are largely transverse; veins brown or pinkish. Thorax and abdomen, ventral surface, pale brown. Legs, pale yellowish-brown, the tibiae with a number of oval white spots. Male genitalia, as in fig. B, figs. 10a and 10b. The parameres are broader than those of the genotype, and the aedeagus a little differently shaped.

Distribution.—South Australia.

Type, ♂ from Lucindale, South Australia (coll. A. H. Elston); paratypes, 3 ♀'s, one from the type locality and two from Adelaide.

Cornutipoini.

The insects comprised in this genus and in the two following genera, though not superficially resembling each other, are evidently fairly closely related, morphologically in the character of the production of the frons into a ledge, spatulate process or a horn, and also as evidenced by the general colouration. While *A. lignosa* is widely distributed in the more settled areas of the continent, *C. scalpellum* appears to be confined to the arid interior regions, and *C. tricornis* to North-Western Australia.

Anacornutipo, gen. nov.

Narrowly wedge-shaped, head nearly twice as broad as long, maxillary plates wide, the frons, vertex and crown, all but the dorsal margin, flat; the anterior edge of the frons is produced so that it overhangs the clypeus, which is almost at right angles to it. The femora of the first two pairs of legs bear a row of short blunt spurs on their interior edges, and the hind tibiae have one spur and a few very small spines.

ANACORNUTIPO LIGNOSA Walker. (Genotype.)

Eurymela lignosa Walker, Homopt. Ins. Suppl. 166, 1858.

Description.—Length, 4·8 mm. Head (fig. C, fig. 13), 2·2 mm. wide, brown mottled with dark brown or black. Pronotum and scutellum, concolorous with the tegmina. Tegmen, opaque, dull brown, chocolate-brown or blackish-brown, with irregular white markings; in some specimens these are arranged as fasciae; the

Fig. C (continued).

Figure 9 .. *Cornutipo scalpellum,* head in profile.
„ 10 .. „ „ tegmen.
„ 11 .. *Cornutipoides tricornis.*
„ 12 .. *Anacornutipo lignosa,* head.
„ 13 .. „ „ head.

apical third of the tegmen may be whitish-hyaline. Thorax, ventral surface, black. Legs marked with a variable pattern of light and dark brown. Abdomen, ventral surface pale yellowish-brown. Male genitalia as in fig. C, figs. 2a and 2b. Subgenital plates narrow, slightly recurved at the apex dorsally, aedeagus with a posterior dorsal spur or prominence. Host plant, *Eucalyptus*, spp.

Distribution.—All States.

Cornutipo, gen. nov.

Eyes semi-globular, distinctly prominent. Head vertical with vertex flat, the frons strongly recurved and produced at the apex into an angular flap-like process; labium extending to the base of the middle pair of legs; maxillary plates narrow. Pronotum with the anterior and posterior margins almost straight, the lateral margins wide, so that the base of the tegmen is not close to the head; propleuron with a narrow posteriorly-directed process extending over the mesopleuron. Tegmina not tectiform apically, the appendix small. Tibiae flattened, sub-dilated, the hind tibiae with a small spur and no spines. Male genitalia very small, the subgenital plates not nearly reaching to the apex of the abdomen.

Cornutipo scalpellum, n. sp.[4] (Genotype.)

Description.—Length, ♂, 5·5-6 mm.; ♀, 8 mm. Head, width, 2·8 mm., the lorae, clypeus and ventral surface of the frons, whitish-yellow with a few small brown markings, the rest of the head pale yellowish-brown mottled with black (fig. C, fig. 9). Pronotum, greyish-brown, or white mottled with yellow or black, some specimens have a median longitudinal pale stripe. Scutellum marked with a pattern of ochreous and black. Tegmen, greyish or whitish with fuscous punctures, veins pale yellowish-white or brown, the proximal costal and claval areas whitish; some specimens have in addition an irregular whitish or hyaline area towards the apex of the tegmen (fig. C, fig. 10). Thorax, ventral surface black and pale straminaceous. Legs, pale and dark brown. Abdomen, ventral surface pale brown. Male genitalia as in fig. C, figs. 1a and 1b. Resembling those of *A. lignosa* in the shape of the subgenital plates and in the possession of an anterior dorsal prominence on the aedeagus. Host plant, *Eucalyptus dichromophloia* (Lake Mackay).

Distribution.—Queensland and Central Australia.

Type, ♂ from Duaringa, Queensland, in the collection of the British Museum. Described from a long series of both sexes.

Cornutipoides, gen. nov.

The species in this genus resembles *C. scalpellum* in the structure of the prothorax and subgenital plates; also the venation and colouration of the tegmina of the two species is similar. The head bears three horns, the frons being produced into an upward-turning horn, and the vertex on each side between the eyes and the margin of the frons, into two downward and inward-projecting horns. The hind tibiae are quadrilateral in section and bear one spur and a few small spines.

Cornutipoides tricornis, n. sp. (Genotype.) (Fig. C, fig. 11.)

Description.—Length, 6 mm. Head, width, 2·2 mm., punctate mottled with ochreous and very dark brown (fig. C, fig. 12). Pronotum and scutellum, yellowish, mottled with dark brown. Tegmen, hyaline mottled with brown, the claval area, which is on a plane with the scutellum, punctate; veins distinct, brown; there may be incomplete anterior and posterior fasciae. Thorax, ventral surface very dark brown. Legs, pale or dark brown, closely appressed ventrally to the body. Abdomen, ventral surface, pale brown. Male genitalia, as in fig. C, figs. 3a

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(4) The late Dr. C. F. Baker had ascribed this name (in manuscript) to this species.

and 3b. Subgenital plates very small, parameres less than half the length of the plates.

Distribution.—North-western Australia.

Type, ♂, paratypes, 1 ♂ and 2 ♀'s; all four specimens in the collection of the South Australian Museum.

Opioni. **Opio,** gen. nov.

This isolated and distinct genus contains only one species. Insects narrowly wedge-shaped; head only slightly wider than long, flat, the maxillary plates, lorae and clypeus being on the same plane as the frons; labium reaching to the base of the hind legs; hind margin of the crown from above, only slightly curved. Hind tibiae with three spurs decreasing in size from the apex of the tibiae to the base.

OPIO MULTISTRIGIA Walker. (Genotype.) (Fig. B, fig. 14.)

Bythoscopus multistrigia Walk., Insecta Saund., Homopt., 105, 1858.

Description.—Length, 7 mm. Head, width, 3 mm., bright yellow with black markings. Pronotum, greyish-yellow with black markings, and a pale median longitudinal stripe. Scutellum, brown and black with two longitudinal yellow bands, which are narrower at the anterior than at the posterior margin. Tegmen (fig. B, fig. 13), long and narrow, black with bright yellow and whitish longitudinal stripes; the posterior costal area may be hyaline. Thorax and abdomen, ventral surface pale yellowish-white. Legs, marked with a pattern of yellow and black. Male genitalia, as in fig. B, figs. 11a and 11b. Host plant, *Casuarina* sp.

Distribution.—New South Wales.

Ipocerus, gen. nov.

Species comprised in this genus have certain characters that separate them from the Eurymelidae, and they cannot be placed in any of the known subfamilies of the Bythoscopidae. The head is Eurymeloid in character, the maxillary plates, frons and lorae being wide and the frontal suture complete anteriorly; the labium is long, reaching to between the bases of the hind legs; and the crown is visible from above as a narrow margin. The pronotum is deeply emarginate, and the scutellum narrow, the anterior corners of the latter not nearly reaching to the sides of the body. The tegmina are not tectiform; they narrow apically and the appendix is large but does not continue round the apex of the tegmen. The hind tibiae bear three rows of spines, three of these on one row being set on enlarged bases, somewhat resembling, but less pronounced than those found in the Eurymelidae proper. The male genitalia consist of long, flat subgenital plates and parameres, both slightly curved inwards apically; they are somewhat Idiocerine in character.

Species in this genus are apparently confined to Western Australia. Mr. D. C. Swan, who collected some specimens of *I. procurrens* in October, 1930, informs me that he took them in the cracks in the bark of *Eucalyptus calophylla,* that the nymphs jumped when disturbed, and that they were not attended by ants.

For convenience this genus is temporarily placed with the Ipoinae, until as a result of further research it becomes possible to assign it either to its correct subfamily or to erect a new subfamily to contain it.

IPOCERUS PROCURRENS Jacobi. (Genotype.) (Fig. C, fig. 5.)

Ipo procurrens Jacobi, Faun. S.-W. Aust., Michaelsen u. Hartmeyer, ii.; 340, 1909.

Description.—Length, 4·8 mm. Head, width, 2 mm., as wide as long, grey or cream-coloured, mottled with brown or black; frons brown with cream-coloured

markings; eyes dark brown (fig. C, fig. 6). Pronotum, concolorous with the head. Scutellum, black with yellowish markings. Tegmen, pale or dark brown with oval, round and irregularly shaped hyaline areas; distal half of appendix, brown (fig. C, fig. 7). Thorax, ventral surface dark brown. Legs, pale yellowish-brown mottled with dark brown, with numerous spines, three of them being set on enlarged bases (fig. C, fig. 8). Abdomen, ventral surface brown. Male genitalia, as in fig. C, figs. 4a and 4b. Subgenital plates and parameres long, narrow and flat, somewhat thickened apically.

Distribution.—South-western Australia.

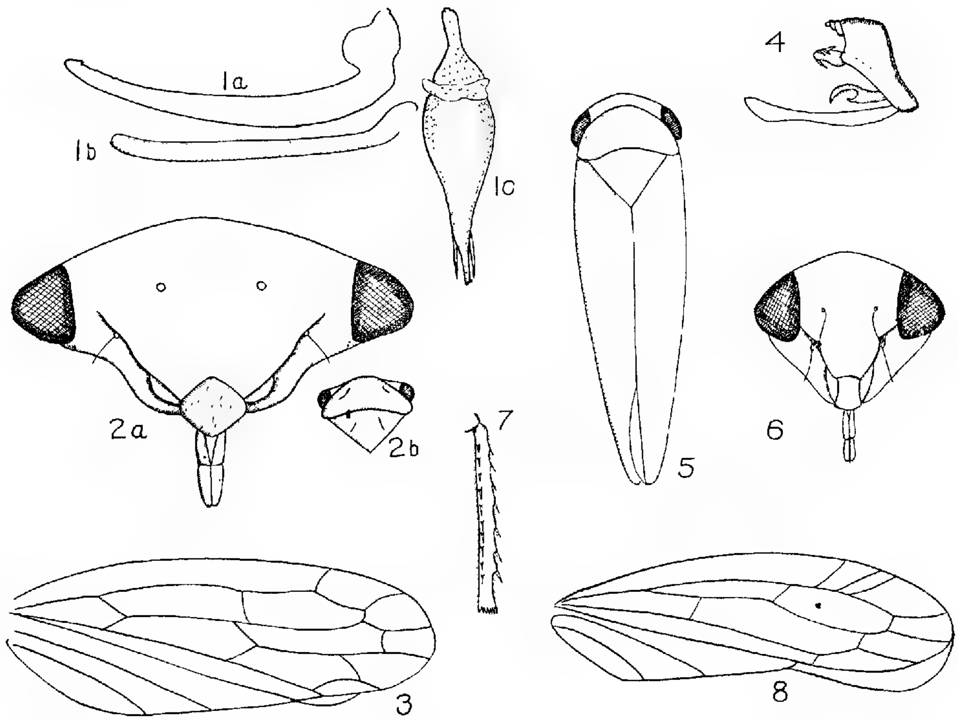

Fig. D.

Figure 1a	..	*Stenoscopus drummondi,*	subgenital plate.
„ 1b	..	„ „	paramere.
„ 1c	..	„ „	aedeagus.
„ 2a	..	*Stenoscopus drummondi,*	head.
„ 2b	..	„ „	dorsal view of head and thorax.
„ 3	..	„ „	tegmen.
„ 4	..	*Idiocerus leurensis,* male	genitalia, lateral view.
„ 5	..	*Idiocerus leurensis.*	
„ 6	..	„ „	head.
„ 7	..	„ „	hind tibia.
„ 8	..	„ „	tegmen.

Bythoscopidae.

Bythoscopinae. **Stenoscopus,** gen. nov.

Head from above wider than long, the frons, of which the posterior margin is ill-defined, lying on a different plane from the rest of the head. The antennae lie in pits below the overhanging lateral margins of the frons, and the ocelli are

situated on the vertex well away from the frons. The eyes are small but prominent, the lorae small, and the clypeus more or less diamond-shaped. The labium is short, not reaching beyond the bases of the fore legs, and the crown of the head is only visible from above laterally against the eyes. The pronotum is wide at the sides, separating the head from the bases of the tegmina, and the anterior and posterior borders are not parallel to each other. The tegmen has a small appendix and only four apical cells; and the hind tibia is armed with numerous spines that arise direct from the tibia itself. The male genitalia consist of long, narrow subgenital plates and parameres, and a flask-shaped aedeagus.

Stenoscopus drummondi, n. sp. (Genotype.)

Description.—Length, 7 mm. Head, width, 2·2 mm., rugose, ochreous, with a pattern of well-defined but variable, very dark brown markings; eyes pale or dark reddish-brown (fig. D, figs. 2a and 2b). Pronotum, dull yellow with dark brown markings. There are two lateral depressions close to the anterior border. Scutellum, bright yellow; lateral angles black. Tegmen, transparent, veins black; venation as in fig. D, fig. 3. Thorax and abdomen, ventral surface and legs dull yellow. Male genitalia as in fig. D, figs. 1a, 1b and 1c.

Type, ♂, from Beverley, Western Australia; paratypes, 2 ♀'s from Bruce Rock, Western Australia (coll. F. Drummond). Type and one of the paratypes in the collection of the South Australian Museum.

Idiocerinae. *Idiocerus* Lewis (type, *I. adustus* H.).

The characters given below are not necessarily of generic significance within the Idiocerinae, but are sufficient to enable the separation of insects belonging to this genus from the Eurymelidae.

Head, triagular in shape; eyes big, not prominent; ocelli lying at the apices of the lateral margins of the frons; clypeus more or less rectangular; maxillary plates narrow, the external margins straight, not curved; antennae long, the flagellae projecting well beyond the sides of the head; labium extending as far as the middle pair of legs. Head from above, the crown broad and as wide in the centre as against the eyes. Tegmen with only two subapical cells between the radius and the cubitus, the appendix very large. Hind tibia with three rows of spines that decrease in size from the apex of the tibia to the base. Male genitalia with the subgenital plates long and narrow, extending well beyond the apex of the abdomen. The parameres are short and flat and do not extend as far as the middle of the plates.

Idiocerus leurensis, n. sp. (Fig. D, fig. 5.)

Description.—Length, 8 mm. Head, width, 2·1 mm., yellowish; eyes, dull red (fig. D, fig. 6). Pronotum and scutellum, pale greenish-yellow. Tegmen, pale greenish, hyaline, veins yellow (fig. D, fig. 8). Thorax and abdomen, ventral surface and legs pale yellow. Male genitalia as in fig. D, fig. 4.

Type, ♂, from Leura, New South Wales (coll. J. W. E.); paratypes, 2 ♀'s, one from the type locality, and one from "Blundells," F.C.T. Type and one of the paratypes in the collection of the C.S.I.R. Division of Entomology at Canberra.

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ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA. NO. 32.

BY J. M. BLACK, A.L.S.

Summary

Callitris Drummondii (Parlat.) Benth. et Hook. Kulde, near Karoonda, *J. B. Cleland;* also grown at Blackwood by E. Ashby from seed obtained at Middle River, Kangaroo Island. This species, whose type came from Western Australia has now been found in our State on Eyre Peninsula, Kangaroo Island, and Murray lands.

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA.

No. 32.

By J. M. Black, A.L.S.

[Read October 11, 1934.]

Plates X. and XI.

Pinaceae.

Callitris Drummondii (Parlat.) Benth. et Hook. Kulde, near Karoonda, *J. B. Cleland;* also grown at Blackwood by E. Ashby from seed obtained at Middle River, Kangaroo Island. This species, whose type came from Western Australia has now been found in our State on Eyre Peninsula, Kangaroo Island, and Murray lands.

Gramineae.

**Stenotaphrum secundatum* (Walt.) O. Kuntze. This "Buffalo Grass," much used for lawns, has established itself in many moist places, sometimes close to the sea, as at the mouth of the Inman River. This is the American species and differs from *S. dimidiatum* (L.) Brongn., the East African and South Indian grass, in having the spikelets 1-3 together in the cavities of the flat rhachis of the spike, instead of 3-5, or even more, in each cavity. The authorities at Kew, who kindly determined our specimens, add: "*S. dimidiatum* has softer and greener foliage than *S. secundatum* and should be better than that species for making lawns." The former has the spike finally exserted from the leaf-sheath on a long peduncle, while *S. secundatum* has the peduncles enclosed in or shortly exserted from the sheath.

Triodia aristata, J. M. Black. Nonning (Gawler Ranges), August, 1928, *J. B. Cleland;* near Mount Kintore (S.-W. of Musgrave Ranges), July, 1933, *Tindale and Hackett.*

Stipa variabilis, Hughes. It is worth noting that this species, and perhaps others belonging to Miss Hughes' section *Falcatae,* have the upper part of the awn straight or almost so in the living state, and that it is in the dried condition that this part of the awn becomes falcate, *i.e.,* curved like a sickle or bent bow.

**Bromus scoparius,* L. Kingscote, Kangaroo Island, November, 1933, *A. B. Cashmore.* Not previously recorded for South Australia, but naturalized in Victoria since 1898.

Cyperaceae.

Tetraria monocarpa, nov. comb. The study of further specimens from near Mount Compass and the Hindmarsh Valley convince me that this plant should be placed in the genus *Tetraria,* Beauv., of which it has the characters. *Tetraria* differs from *Cladium, Gahnia* and *Lepidosperma* in the glumes distichous or almost so (not spirally arranged round the rhachilla), from *Schoenus* by the rhachilla short and straight (not lengthened and flexuose under the flowering glumes), and the spikelet only 2-flowered, the lower flower male or barren, the upper one fertile and nut-bearing. In this species the spikelets are very slightly compressed, at first almost subulate, 6-9 mm. long, about 1 mm. broad, with 8-9 distichous glumes, the first 5 or 6 empty, the 6th or 7th bearing a male flower with 3 stamens or a perfect but sterile flower, the 7th or 8th with a pistil and 3 stamens and ripening the solitary nut, the 8th or 9th glume empty and rather smaller; the 4 uppermost glumes are 5-6 mm. long, obtusely notched,

with a mucro usually shorter than the rounded lobes; style 3-branched, articulate on the nut, which is obovoid, trigonous from summit and shows scarcely any sign of an adherent style-base. In the words of C. B. Clarke, the style-base must be considered as "confluent with the rounded summit of the nut," which is sometimes the case in *Tetraria* as defined by that author; hypogynous bristles none (pl. x., fig. 4).—*Schoenus monocarpus,* J. M. Black in Trans. Roy. Soc. S. Aust., 52 : 225 (1928); *Cladium monocarpum,* J. M. Black *l.c.* 53 : 261 (1929).

Appears to be endemic in the Mount Lofty Range and Kangaroo Island.

Tetraria capillaris (F. v. M.) nov. comb. This also appears to be a *Tetraria,* as it has distichous glumes, a straight rhachilla and usually 2 flowers, of which only the upper one is fertile. The spikelets are about 5 mm. long, $1\frac{1}{4}$-$1\frac{1}{2}$ mm. broad, acute, with 5-6 glumes, the first 3 or 4 empty and smaller, the 3rd or 4th glume enclosing a barren flower consisting of pistil and 3 stamens or sometimes empty, the 4th or 5th with a fertile flower, and the 5th or 6th empty, small, membranous, pubescent towards summit; style 3-branched, with a conspicuous conical scabrous base, which is persistent on and as long as the nut; no hypogynous bristles. The stems are numerous and capillary (less than $\frac{1}{4}$ mm. diam.) (pl. x., fig. 5).—*Chaetospora capillacea,* Hook. f. Fl. Tasm. 2 : 81, t. 141 A (1855-59) non Nees in Linnaea 10 : 192 (1836); *Ch. capillaris,* F. v. M. Fragm. 9 : 34 (1875); *Elynanthus capillaceus,* Benth. Fl. Aust. 7: 377 (1878); *Schoenus capillaris,* F. v. M. in Journ. Roy. Soc. N.S.W., 27 : 85 (1893); *Cladium capillaceum* (Hook. f.) C. B. Clarke, M.S. fide Cheeseman, N.Z. Fl. 789 (1906).

The name *T. capillacea* cannot be adopted for our plant because it is already occupied by *T. capillacea* (Thunb.) C. B. Clarke in Consp. Fl. Afr. 5 : 659 (1895), a South African species. *Elynanthus,* to which genus Bentham transferred our plant, is now treated as a section of *Tetraria.* In our State *T. capillaris* has only been found on Kangaroo Island; it also inhabits Victoria and Western Australia.

Schoenus deformis (R. Br.) Poir. (1811). Goolwa Road, 2 miles from Middleton, on travertine limestone, January, 1934, *J. B. Cleland* (pl. x., fig. 7). At first these specimens suggested a new species, because each spikelet had evidently 2 subulate involucral bracts, of which the lower one is 2 to 3 times as long as the 3-flowered spikelet, which is 12 mm. long and $2\frac{1}{2}$ mm. broad, and the upper bract is about as long as the spikelet. R. Brown's originals were gathered at Memory Cove, south of Port Lincoln, over 130 years ago, and as they are preserved in the Natural History Section of the British Museum, one of the specimens collected on the Goolwa Road was sent to Kew for comparison. Mr. Ballard reports:—"There is no doubt that the 2 are identical. There are 2 involucral bracts subtending the spikelet in the Brown specimen, in spite of the statement to the contrary in the Flora Australiensis." Brown's original description (Prodr. 232) also overlooks the shorter bract. This small rush, 5-12 cm. high, has only been found in the 2 localities mentioned and appears to be endemic in South Australia. The brown basal leaf-sheaths, bearded at summit, are 1-2 cm. long, and the blades are filiform, channelled, minutely ciliolate on the margin and from $\frac{1}{2}$ to nearly as long as the stems.

Amaryllidaceae.

Calostemma purpureum, R. Br. The depressed-globular fruit has a purplish-brown, membranous, longitudinally 6-nerved pericarp, adherent to which is the solitary seed, with a thin membranous testa and a hard albumen (endosperm) surrounding the embryo. In spite of Bentham's statements in the Fl. Aust. and the Gen. Pl. the fruit is not succulent, but hard and solid.

The structure and germination of the seed of this and other Amaryllidaceous plants has been discussed by Robt. Brown in his Prodr. 298 (1810), and Trans. Linn. Soc. 12 : 143 (1818); by Achille Richard in Ann. Sci. Nat. série 1 : 2 : 12 (1824); by Prillieux, *l. c.* série 4 : 9 : 97 (1858), and by H. Baillon in Bull. Soc. Linn. Paris, p. 4 (1874).—"Sur le développement et la germination des graines bulbiformes des Amaryllidées." This paper is not available here, but a short note by Pax in the Nat. Pflanzenfam. (1889) says that according to Baillon *Calostemma* has no normal embryo in the embryo-sac, but develops a bulbil instead.

The drawings on pl. xi., fig. 3, show progressive stages in the germination of the seed, which is at first tightly enclosed in the pericarp of the fruit. The seeds germinated while lying dry in a drawer; they were then transferred to moist flannel and afterwards to a pot, where they attained the development shown in fig. 3, I and J.

I leave to embryologists the task of investigating further the true nature of the seed and its germination, only observing that in this monocotyledonous plant there emerge from the seed 1 to 3 cotyledons, 2 being apparently the most usual number.

Iridaceae.

**Watsonia Meriana* (L.) Mill. This bulbous plant, from about 1½ to 2 m. high, with handsome pink or red funnel-shaped curved flowers and sword-shaped equitant leaves 2-3½ cm. broad, may now be considered established in the Mount Lofty Range, usually in gullies and near creeks. Flowers October-November.—A native of South Africa, it is a garden escape here and in the eastern States.

Restionaceae.

Leptocarpus Brownii, Hook. f. Waitpinga Road and Hall's Creek Hills, both near Encounter Bay, *J. B. Cleland.* Hitherto only collected on Eyre Peninsula and in the South-East.

Casuarinaceae.

Casuarina Decaisneana, F. v. M. Plain between Musgrave and Mann Ranges, June, 1933, *Tindale and Hackett.* This is the first record of the "Desert Oak" in South Australia. It has previously been collected at Mount Mueller, south of the Roper River, N.A., and in the MacDonnell Range and near the Finke River, C.A. In our specimens the cones are 4½-5 cm. long by about 3 cm. diam.

Proteaceae.

Hakea lorea, R. Br. Leaves terete, simple, ashy-grey, minutely pubescent, 20-60 cm. long, 2-2½ mm. diam.; perianth densely pubescent with hairs about 1 mm. long, the tube 10-12 mm. long.

Arkaringa Creek; Everard Range; Musgrave Ranges to Western Australian border. West and Central Australia; Western New South Wales and Queensland.

Hakea Ivoryi, Bailey. Leaves terete, once or twice forked or trisect, rarely simple, greyish-green, smooth and only microscopically appressed-pubescent, 5-18 cm. long, about 1½ mm. diam., the segments 4-10 cm. long; perianth pubescent with hairs about ½ mm. long, the tube 6-8 mm. long.

Musgrave Ranges.—Western New South Wales (Darling and Paroo Rivers); Queensland (near Cunnamulla on the Warrego).

Hakea intermedia, Ewart et Davies. Leaves terete, ashy-grey, 1-3 times forked or trisect, usually 4-7 cm. long, rarely 10 cm. long, about 1½ mm. diam.,

smooth, the segments 1-3 cm. long, more divergent and paler than in *H. Ivoryi;* perianth pubescent as in the latter, the tube about 8 mm. long.

North of Cooper's Creek. Central Australia (along Finke River). Western New South Wales and Queensland.

Hakea Ednieana, Tate. Near *H. intermedia* in the leaves, which are $1\frac{1}{2}$-4 cm. long, about 1 mm. diam., ashy-grey, once or twice forked or trisect, smooth but appressed-pubescent under the lens, whereas those of *H. intermedia* are almost glabrous, the segments strongly divergent, $\frac{1}{2}$-2 cm. long; perianth densely whitish-pubescent, the tube only 4 mm. long.

Aroona Range, Mount Lyndhurst, Leigh's Creek, Blinman, Moolooloo (all in Flinders Range) and apparently endemic.

All these species have, as far as we know, no involucral bracts covering the young flowers in the raceme and therefore belong to the section *Grevilleoides,* Benth., which is also distinguished by an obliquely lateral stigmatic disk. *H. Ednieana* has, however, in contradistinction to the other 3 species, an erect stigmatic cone, which is a character of the section *Conogynoides,* another character of that section being the involucral bracts on the young raceme. The very young racemes require examination to decide whether they are naked or involucrate. In all 4 species the bark is rough and somewhat corky, the leaves or their segments are rigid and pungent-pointed, the hairs are centrifixed, the young capsule is almost oblong in outline, and the seed-wing is only decurrent for a very short way along one side of the nucleus.

H. lorea, R. Br. var. *fissifolia,* F. v. M. Fragm. 6 : 190 (1868). The size of the leaves is not described; the localities given are Darling River, New South Wales, and sources of Gilbert River, Queensland. The Queensland specimen, lent me by the Victorian National Herbarium, shows leaves once or twice forked, the longest 17 cm., the segments 6-7 cm. long. Maiden (For. Fl. N.S.W. 5 : 159) mentions specimens from that State with segments 1-$1\frac{1}{2}$ inch ($2\frac{1}{2}$-$3\frac{3}{4}$ cm.) long. It seems possible, therefore, that var. *fissifolia* is a mixture, the Queensland specimens being perhaps *H. Ivoryi,* and those from New South Wales *H. intermedia.*

Santalaceae.

Santalum lanceolatum, R. Br. The typical broad-leaved form has again been found in South Australia—this time by Messrs. Tindale and Hackett between the Musgrave and Mann Ranges, June, 1933. Some of the leaves are very obtuse or even notched. "An important native fruit, called *koparta*"—note of the collectors.

Loranthaceae.

Loranthus grandibracteus, F. v. M. Cooper's Creek to Pandi Pandi, fruiting August, 1934, *J. B. Cleland.* Berry (not previously described) ovoid-oblong, pale-yellow, 8-10 mm. long.

Polygonaceae.

Polygonum glabrum, Willd. Perennial, creeping in mud (at base), glabrous except for a row of minute erect hairs along margin of leaves as in *P. lapathifolium;* stems about 175 cm. high and at least 1 cm. thick; leaves lanceolate, 10-15 cm. long or more, 10-18 mm. broad; petioles 1-$2\frac{1}{2}$ cm. long; spikes $2\frac{1}{2}$-3 cm. long.

Diamantina River at Pandi Pandi Station, September, 1934, *J. B. Cleland.*

Danser, in Proc. Roy. Soc. Qld. 39 : 3 : 23 (1927), first records this Asiatic, African, and American species for Australia (Aramac, Qld.), and adds:—"Except for its glabrous character, it is difficult to distinguish it from *P. attenuatum, celebicum* and *javanum.*"

CHENOPODIACEAE.

Chenopodium.

The following arrangement of 4 sections of *Chenopodium* is based on a revision published by Mr. Paul Aellen, of Bâle, a specialist in *Chenopodiaceae,* in Engler's Botanisches Jahrbuch (1930), Verhandlungen der Naturforschenden Gesellschaft in Basel (1930), and the same (1933).

The genus *Dysphania* has been a trouble to botanists for more than a century. Its creator, Robert Brown, placed it next to *Chenopodium,* and Bentham followed his example in the Fl. Aust. (1870). In the Genera Plantarum (1883), however, Bentham and Hooker transferred it to *Illecebraceae.* Other botanists —Baillon (1888), Pax (1889)—placed it in *Caryophyllaceae,* while in 1927 Pax and Hoffmann created for its reception a new family—*Dysphaniaceae.*

There is much to be said in favour of Aellen's inclusion of *Dysphania* in *Chenopodium.* His sections *Dysphania, Tetrasepala* and *Atriplicina* show a gradual ascent from 1 perianth-segment to the 5 segments which normally characterise *Chenopodium.* All three, as well as the section *Orthosporum,* have chiefly female flowers in each cluster, and where the uppermost flowers are bisexual, or rarely male, there is only 1 stamen. The seed is erect and the embryo encircles only about $\frac{3}{4}$ of the albumen, the cotyledons lying towards the upper end of the seed and the radicle being inferior. In the illustrations of Mueller's Iconography of Australian Salsolaceous Plants the embryos in the section *Orthosporum* are shown as completely annular, with cotyledons and radicle both at the base of the seed, but my examination of seeds in that section indicates that the length and position of the embryo are the same as they are shown in Mueller's illustrations of Dysphania, i.e., the embryo is too short to encircle more than $\frac{3}{4}$ of the albumen. Bentham and Hooker, in describing the section Orthosporum, say:—"Semen erectum, embryone imperfecte annulari," which agrees with my observations. If *Dysphania* were retained as a genus, it would therefore seem that the 3 sections, *Orthosporum, Atriplicina,* and *Tetrasepala,* should be detached from *Chenopodium* and united with *Dysphania.* Aellen's proposal appears to be the simpler and better one.

Section *Orthosporum,* R. Br. Perianth-segments normally 5, concave inside, narrowed and not hooded at summit, not swollen or gibbous at base; flowers in each cluster mostly female, the terminal ones usually bisexual with only one stamen; style 2-branched; fruit consisting of the hyaline adherent pericarp, the crustaceous testa and the vertical dark-red compressed-obovoid seed; embryo encircling about $\frac{3}{4}$ of the albumen and therefore dorsal and horseshoe-shaped; pubescent, prostrate or ascending herbs; flower-clusters axillary.

A. Perianth-segments narrow, erect or slightly incurved at summit, whitish when ripe.
  B. Segments narrow-linear, rounded on back, hairy towards summit .. .. *Ch. pumilio* 1
  B. Segments pointed at summit, each with a conspicuous sharply-toothed or fringed vertical wing or crest along the keel .. *Ch. cristatum* 2
A. Perianth-segments broad, keeled, horizontally incurved, thickened and usually black when ripe .. .. *Ch. melanocarpum* 3

Section *Atriplicina,* Aellen. Perianth-segments normally 4, dilated, hardened and gibbous near base; otherwise as *Orthosporum.*

Almost glabrous plant .. .. *Ch. atriplicinum* 4

Section *Tetrasepala,* Aellen. Perianth-segments 4, greenish, slightly hooded; flower-clusters in long leafless spikes; otherwise as in *Orthosporum.*

Perianth and leaves glandular-pubescent .. .. *Ch. rhadinostachyum* 5

Section *Dysphania* (R. Br.) Aellen. Perianth-segments 1-3, hooded, white reticulate and almost hyaline when ripe; flower-clusters spicate or axillary; style simple or 2-branched; otherwise as in *Orthosporum*.

C. Flower-clusters forming a dense leafless spike; perianth-segments 3.
D. Segments free, erect, shortly stalked .. .. .. *Ch. plantaginellum* 6
D. Segments united in a cup at base, finally horizontal .. *Ch. simulans* 7
C. Flower-clusters axillary, crowded or distant in a leafy spike; perianth-segments erect.
E. Segments 1 or 2, easily separating; style 2-branched .. *Ch. myriocephalum* 8
E. Segments 3, rarely 2, united at base; style simple .. *Ch. Blackianum* 9

1. *Ch. pumilio*, R. Br. Prodr. 407 (1810). This name, given by Brown to a small form from Kangaroo Island, has been ignored by all authors since Brown and Bentham, and has been treated as synonymous with *Ch. carinatum*, R. Br. Aellen, after studying Brown's originals, concludes that the name *pumilio* must be reserved for the species with linear almost erect perianth-segments, rounded on the back, hairy near the summit and without any appendages. The leaf-blades vary from small and entire to $2\frac{1}{2}$ cm. long and sinuate-lobed, with a slender petiole nearly as long as the blade (pl. x., fig. 8).—*Ch. carinatum*, auctt. pro parte non R. Br.

South Australia.—Adelaide Plains; Mount Lofty Ranges, Ardrossan, Yorke Peninsula; Dudley Peninsula, Kangaroo Island; River Murray; Gladstone; Beresford Springs. All the Australian States. One of the Gladstone specimens has prostrate stems only 2-4 cm. long and entire leaves 3-5 mm. long, thus coming very near to the description of Brown's type. The Kangaroo Island specimens have also mostly entire leaves.

The true *Ch. carinatum*, R. Br. and partly of Bentham and most other botanists, is recorded from New South Wales (the type came from Port Jackson), Queensland, and Western Australia, but not from Victoria or South Australia. Brown describes the perianth-segments thus:—"Perianthiis alato-carinatis hispidis." Aellen, in Verh. Naturf. Ges. Basel 44 : 1 : 313 (1933), says:—"Perianth usually longer than broad, elongated, delicately scarious or slightly herbaceous, light-coloured, the segments usually closely beset with hairs, fringes and protuberances, the keel usually most strongly developed in the upper part of the perianth-segments, not conspicuously rounded on the angle, usually winged in the upper part."

The figure here given (pl. x., fig. 9) is copied from one of those published by Aellen, *l.c.*, p. 316. Synonyms:—*Ch. holopterum*, Thellung et Aellen in Mitt. Naturf. Ges. Soloth. Heft 8 : 57 (1928); *Ch. trigonocarpum*, Aellen in Verh. Naturf. Ges. Basel 41 : 99 (1930); *Ch. cristatum*, F. v. M., var. *holopterum*, Thellung in Vierteljahrsschr. Naturf. Ges. Zürich 64 : 724 (1919).

Aellen divides *Ch. carinatum* into 2 varieties: var. *holopterum*, which, as he states, *l.c.*, p. 312 = R. Brown's type, and var. *melanocarpum*, which I deal with below.

2. *Ch. cristatum*, F. v. M. Fragm. 7 : 11 (1869). This is a well-defined species, easily recognised by the broad vertical wings of the perianth-segments cut into long irregular ciliate teeth (pl. x., fig. 10).

South Australia.—Renmark; Mannum; Lake Barmera; Sutherlands; Mount Bryan, Mount Parry, Woolshed Flat, Moolooloo, Beltana (Flinders Range); Eurelia; Curnamona; Alberga River; Fowler's Bay; Ooldea. All the Australian States.

3. **Ch. melanocarpum**, nov. comb. Herba pilis glanduliferis septatisque praedita; caules procumbentes, rigidi, striati; folia ovato-lanceolata, $1\text{-}2\frac{1}{2}$ cm. longa, breviter sinuato-lobata, longe petiolata; glomeruli 12-25-flori, densi, axillares, mox distantes, 3-6 mm. diam.; perianthium fructiferum depressum, circa

2 mm. latum, latius quam longum, deorsum ad medium 5-lobatum, lobis oblongis, obtuse carinatis, durescentibus nigrescentibusque, rarius ad maturitatem viridibus, pilosis, valde et fere horizontaliter incurvis, fructum omnino tegentibus; stamen, dum adest, 1; stylus brevis, ramis 2 stigmatiferis longis; fructus erectus, rubellus, $\frac{1}{2}$-$\frac{3}{4}$ mm. longus; embryo dorsalis, hippocrepicus, dodrantem albuminis cingens, radiculâ inferâ (pl. x., fig. 11).—*Ch. carinatum* var. *melanocarpum*, J. M. Black in Trans. Roy. Soc. S. Aust., 46 : 566 (1922) *Ch. holopterum*, Thellung et Aellen pro parte; *Ch. carinatum*, R. Br. var. *melanocarpum* (Black) Aellen in Verh. Naturf. Ges. Basel 44 : 313 (1933).

South Australia—Moolooloo (Flinders Range); Everard and Musgrave Ranges. Central Australia—Finke River; MacDonnell Ranges; Mount Liebig. New South Wales—Broken Hill. Western Queensland. Western Australia—Mount Squires, near Cavanagh Range.

Now that the original *Ch. holopterum* (misquoted in Fl. S.A. 683 as *Ch. holocarpum)* has been recognised by Aellen as equivalent to Brown's type of *Ch. carinatum*, there seems good reason for raising this variety to specific rank. It is essentially a dry-country plant and is distinguished from all other species by its perianth-lobes, which, although erect and greenish in flower, become later so much incurved as to be horizontal, thickened, hard and usually blackish, closing over the fruit and completely concealing it.

4. *Ch. atriplicinum*, F. v. M. Easily distinguished by its subglabrous character, mostly hastate leaves on long petioles, the fruiting perianth-segments 4, erect, glabrous, whitish, somewhat hardened, acuminate, $2\frac{1}{2}$-3 mm. long, dilated at base into prominent irregular tubercles and partially exposing the fruit, which is $1\frac{1}{2}$ mm. long, rugose-granulate (pl. x., fig. 12).—*Scleroblitum atriplicinum* (F. v. M.) Ulbrich (1934).

Dry districts of South Australia, Victoria, and New South Wales.

5. *Ch. rhadinostachyum*, F. v. M. Perianth 1 mm. long, the lobes hairy, greenish, boat-shaped, connected in the lower half by a pale membrane, hooded at summit and tapering towards base; seed $\frac{1}{2}$-$\frac{3}{4}$ mm. long; plant glandular-pubescent, the leaves sinuate-lobed and petiolate, the flower-clusters in "mouse-tail" leafless spikes, which are sometimes panicled (pl. x., fig. 13). The perianth-segments in Icon. Salsol. Plants, pl. 33, are much too acute.

South Australia—Blyth Range. Central Australia—Finke River; MacDonnell Ranges, Mount Liebig; Macdonald Downs; Connor's Well. Western Australia—Mount Squires; Victoria Desert; Fortescue River.

I have seen no specimen corresponding to *Ch. inflatum*, a new species described by Aellen as having inflated bladdery glabrous perianth-segments and a horizontal fruit. The localities given are Ashburton River, Western Australia, and Bulloo Range, Queensland.

6. *Ch. plantaginellum* (F. v. M.) Aellen in Engl. Bot. Jahrb. 63 : 5 : 487 (1930). "Mouse-tail" spikes $1\frac{1}{2}$-7 cm. long; leaves small, entire; fruiting perianth $\frac{1}{2}$ mm. long by $1\frac{1}{2}$ mm. broad, of 3 whitish glabrous bladdery deeply-hooded segments, their claws forming a short stipes; style simple or rarely 2 distinct styles (pl. x., fig. 14).—*Dysphania plantaginella*, F. v. M. Fragm. 1 : 61 (1858).

South Australia—Mount Lyndhurst; Koonamore. Central Australia—Finke River; MacDonnell Ranges. North Australia—Sturt's Creek. Western Australia—Ashburton River.

7. *Ch. simulans*, F. v. M. et Tate in 2nd Cens. (1889). A small erect glandular-pubescent plant, with petiolate ovate-oblong subsinuate leaf-blades, which are 1-2 cm. long, and dense "mouse-tail" sessile flower-spikes 8-14 cm. long; fruiting perianth $1\frac{1}{2}$ mm. long, $2\frac{1}{2}$ mm. broad becoming whitish, with a cup-like usually papillose fruit-enclosing base and 3 bladdery glabrous incurved

depressed lobes, swollen and rounded above the seed, bordered on the outer margin by short horizontal hyaline wings and completely concealing the smooth fruit, which is about ½ mm. long; style 2-branched (pl. x., fig. 15).—*Dysphania simulans,* F. v. M. et Tate in Trans. Roy. Soc. S.A. 8 : 71 (1886); *Ch. Osbornianum,* Aellen in Engl. Bot. Jahrb. 63 : 5 : 488 (1930).

South Australia. Salt flats on west side of Lake Eyre, *M. Murray;* Koonamore (north of Broken Hill railway) *T. G. B. Osborn.*

According to Aellen there was no type or co-type of *Ch. simulans* in Europe, and in 1930 he had apparently not seen Mueller's Icon. Salsol. Plants, pl. xxxiv. It seems to have thus come about that he re-described *Ch. simulans* as *Ch. Osbornianum* on a specimen from Koonamore.

8. *Ch. myriocephalum* (Benth.) Aellen in Engl. Bot. Jahrb. 63 : 5 : 488 (1930). Slightly glandular-hairy, with several ascending much-branched stems 10-25 cm. long; leaf-blades ovate-oblong, entire, 2-8 mm. long, on slender petioles; flower-clusters axillary, 1-2½ mm. diam., the lower ones distant, the upper ones approximate or crowded into leafy spikes; fruiting perianth-segments 1 or 2 to each flower, glabrous, bladdery, white, hooded, narrowed towards base, ¾ mm. long; style 2-branched; seed under ½ mm. long; stamen 1, but seldom present; proportion of fruits to perianth-segments observed in various clusters: 24 to 30; 32 to 46; 32 to 37; 25 to 36; 45 to 80 (pl. x., fig. 16).—*Dysphania myriocephala,* Benth. Fl. Aust. 5 : 165 (1870).

South Australia—Swamps and lakes near Murray River at Barmera, Paringa, Morgan, Swan Reach; Lake Boolka; Macumba and Coglin Rivers; Hamilton Bore; Diamantina River; Cordillo Downs. Victoria—River Murray near Mildura. Western New South Wales; Queensland; Western Australia.

9. *Ch. Blackianum, Aellen, l.c.,* p. 487 (1930). Papillose-glandular when young, glabrous or almost so in the adult stage, the stems 5-9 cm. long, the petiolate obovate entire leaf-blades 2-4 mm. long; clusters axillary, the upper ones and those on the short branches crowded together, about 2 mm. diam.; fruiting perianth-segments as in the preceding, but 3 or sometimes 2 to each flower and more united at base; style simple or rarely 2 distinct simple styles; stamen 1, when present; seed about ¼ mm. long, shining; proportion of fruits to perianth-segments in clusters examined: 23 to 66; 30 to 84; 20 to 50 (pl. x., fig. 17).—*Dysphania littoralis,* R. Br. Prodr. 411 (1810).

South Australia—Near Marree; Macumba River. Central Australia—Finke River; MacDonnell Ranges. Queensland—Flooded ground near Will's Creek. Northern Australia—Near coast. Western Australia—Mount Squires.

As pointed out by Aellen, Brown's specific name cannot be carried forward into *Chenopodium* on account of *Ch. littorale,* Thunb., a synonym of *Atriplex littoralis,* L., and *Ch. littorale,* Moq., an uncertain Australian species.

These 2 species (Nos. 8 and 9) have so much in common that it is not surprising that they were united by Mueller and most subsequent botanists as *Dysphania littoralis.* *Ch. myriocephalum* is a larger looser plant than *Ch. Blackianum.*

Bassia.

Dr. E. Ulbrich, in the 2nd edition of Die Natürlichen Pflanzenfamilien, vol. 16c, p. 532, *et seq.* (1934) deals in a painstaking and exhaustive manner with the *Chenopodiaceae.* He transfers all the Australian species now placed in *Bassia* to 5 other genera, of which 3 are new. They are:—*Austrobassia* (fruiting perianth cartilaginous at base); *Dissocarpus* (fruiting perianths hardened and connate in a cluster); *Sclerolaena* (fruiting perianth bony at base); *Coilocarpus* (fruiting perianth coriaceous to the summit), and *Sclerobassia* (fruiting perianth bony to the summit). The name *Bassia* (fruiting perianth membranous) is reserved for some 10 Mediterranean and Asiatic species.

This proposal, involving the re-naming of our Australian *Bassias* (some 50 in number) raises the question as to whether such a sweeping change is justified. The fruiting perianths of our species vary from membranous or coriaceous at base, as in *B. sclerolaenoides* and *B. Muelleri*, to hard and bony, as in *B. bicornis* and *B. paradoxa*. The transition is gradual from the 2 former species which belong to the sections *Echinopsilon*, Volkens and *Eriochiton*, R. H. Anderson, with "perianth remaining membranous and not at all, or very slightly hardened in the fruiting stage" (Anderson), to the 2 latter species with very hard fruiting perianths, which belong to the sections *Anisacantha*, Volkens and *Dissocarpus*, Volkens. The sections *Echinopsilon* and *Eriochiton* have practically the same perianth as the typical *Bassias* of the Mediterranean and Western Asiatic regions, and it may be remarked that Allioni, the author of the genus *Bassia*, says:— "The substance of the calyx and receptacle having become firm and *coriaceous*, forms a round flattened fruit (calycis et receptaculi substantia firma et coriacea reddita fructum rotundum efficit complanatum)." This description applies to *B. muricata*, a North African species.

It is difficult to see how *Austrobassia* and *Sclerolaena* can be maintained as separate genera. *B. decurrens, B. intricata, B. quinquecuspis*, and *B. divaricata* have all the same sort of fruiting perianth—hard but not very thick—and yet the 2 former are placed by Ulbrich in *Austrobassia* and the 2 latter in *Sclerolaena*.

Neither does the revival of the genus *Dissocarpus*—originated by F. v. Mueller, but afterwards abandoned by him as unnecessary—appear as a happy decision. If one may quote an analogy from another family, *Eucalyptus Lehmannii* has the fruiting receptacles united in a dense woody mass, just as is the case with the fruiting perianths of *Bassia paradoxa*, but I do not know that any botanist has suggested forming a new genus based on *E. Lehmannii*.

Even when the species with hardened perianths are included, *Bassia* remains a well-defined genus, and I think most Australian botanists will favour its retention for all our species.

Bassia Blackiana, Ising. 22 miles west of Oodnadatta, August 5, 1933, *J. B. Cleland*. More hairy than in the type-specimens collected by Mr. Ising, the leaves, especially the young ones, silky-villous and the perianth-tube hairy.

Atriplex paludosum, R. Br. Specimens from Cape Thevenard, collected by Prof. Cleland, show that, while the leaves are usually small and entire, some of those at the base of the flowering branches may be fully 3 cm. long, cuneate at base, acute at summit, and with 1 or 2 coarse lobes along each margin.

Salicornia Blackiana, Ulbrich in Nat. Pflanzenfam. ed. 2 ; 16c ; 553 (1934) in place of *S. pachystachya*, J. M. Black (1921) because that name is preoccupied by *S. pachystachya*, Bunge ex Ungern-Sternberg (1866), a species of Madagascar.

AIZOACEAE.

Sarcozona, nov. gen.

(Ex verbis graecis σαρξ, σαρκος, carnis, et ζωνη, cingulum, zona, involucrum).

Folia opposita, carnea, trigona; flores 1-3 terminales, sessiles in axillâ foliorum summorum; perianthium liberum sed vaginâ communi carneâ cyathiformi duarum bractearum foliacearum accrescentium arcte cinctum; perianthii lobi 4, erecti, duo exteriores foliacei, duo interiores minores, late scarioso-marginati; petala linearia, bi-tri-serialia; stigmata 4-5, erecta; stamina biserialia, numerosa; ovarium 4-5-loculare, placentis parietalibus; fructus ventricosus, succulentus, in vaginâ bractearum permanens, indehiscens (ut in *Carpobroto)*; semina numerosa (pl, xi., fig. 2).

S. Pulleinei, nov. comb.—*Carpobrotus Pulleinei*, J. M. Black in Trans. Roy. Soc. S.A. 56 : 40 (mutatis mutandis), t. 1, fig. 3 (1932).

The new genus is rendered necessary by N. E. Brown's discovery, on specimens forwarded to him, that the outer covering of the perianth does not consist of 2 lobes, as was stated in my original description, but is really a sort of fleshy cup-shaped involucre, formed by the common sheath, or connate sheaths, of 2 small leafy bracts. This sheath embraces the perianth closely, but is quite free from it. The real perianth has therefore 4, and not 6 lobes as originally described, the 2 outer ones small, but green and leaflike, the 2 inner ones still smaller and consisting chiefly of a broad rounded scarious margin. The red petals (in the only known species) number 20 to 40, in 2-3 rows, and are about 7 mm. long in specimens from the Gawler Ranges and Emu Downs, South Australia, and 11 mm. long in those from the Barrier Range, New South Wales. The anthers and filaments are white; the ovary 4- rarely 5-celled.

Mr. Brown considers that the plant differs in so many characters from *Carpobrotus* that a new genus (so far monotypic) should be created for its reception, and I have followed his advice as that of the leading authority on the *Mesembryanthemeae*.

Another correction, kindly made by Mr. Brown in the name of one of our introduced species, is *Drosanthemum candens* (Haw.) Schwantes, instead of *Mesembryanthemum floribundum*, Haw.

The genus *Gunniopsis*, established by Pax in 1889 for species of *Aizoon* with 4 valvate perianth-lobes, is discarded by Pax and Hoffmann in the second edition of the Pflanzenfamilien (1934), and the species so named (2 in South Australia) are replaced in *Aizoon*.

Neogunnia, Pax et K. Hoffm. in Nat. Pflanzenfam. ed. 2 : 16c : 225 (1934) takes the place of the genus *Gunnia*, F. v. M. Rep. Babb. Exped. 9 (1859), because of the prior *Gunnia*, Lindl. (1834) in *Orchidaceae*. This change affects 1 South Australian species, which becomes *N. septifraga* (F. v. M.) Pax et K. Hoffm.

Cruciferae.

**Conringia orientalis* (L.) Andrz. This glabrous European weed, with whitish petals, entire oblong stem-clasping leaves and tetragonous pods 10-12 cm. long, has been collected near Hamilton, South Australia, by Worsley C. Johnston. It was recorded several years ago in North-West Victoria.—*Erysimum orientale* (L.) Miller. *Conringia*, Heist. differs from *Erysimum* in its glabrous character, whitish (not yellow) flowers and cordate-clasping stem-leaves.

Geococcus pusillus, J. Drumm. Seven miles east of Iron Knob, Eyre Peninsula, *J. B. Cleland*. A new district for this species.

Leguminosae.

Acacia dictyophleba, F. v. M. East of Camp 9, plain between Musgrave and Mann Ranges, June 29, 1933; Camp 18, 2 miles north-west of Konamata, on sandhills with poplar and tea-tree, July 16, 1933, *Tindale and Hackett*. In these specimens, as well as in others from north of Marree, Cordillo and Minnie Downs and Finke River, C.A., the phyllodes have normally only 2 longitudinal nerves, although sometimes a third one may extend from the base half way or more upwards. The species should therefore be placed next to *A. montana*, Benth., from which it differs in its usually longer phyllodes, its longer peduncles, which are solitary or 2-3 in the axil, its shorter petals, its much longer, glabrous, shining pod and its transverse seeds.

Acacia notabilis, F. v. M. Ulpara Waterhole, Mount Crombie, south-west of the Musgrave Ranges, July 19, 1933. "Seeds ground up by natives and eaten as 'Konakandi,' *i.e.*, damper," *Tindale and Hackett*. This is apparently the form with conspicuous lateral reticulate nerves on the phyllodes, raised to specific rank as *A. validinervia*, Maiden in Journ. Roy. Soc. W.A. 13 : 15 (1928),

on specimens collected by Helms in the Cavenagh Range, Western Australia, in 1891. I question whether it can even be considered a variety. Our specimens, from various parts of the State, show great diversity in the strength or faintness of the lateral nerves. The petals are never "quite glabrous," as stated by Maiden in describing his new species, nor "silky-pubescent," as stated by Bentham (Fl. Aust. 2 : 365), but are always papillose in the upper part, the papillae sometimes lengthening into a few minute hairs at the very tip.

Pultenaea tenuifolia, R. Br. Kersbrook (Mount Lofty Range), *C. M. Eardley*. Leaves linear-lanceolate, 1-1½ mm. broad, the margins not involute, but only incurved, so that the upper surface is exposed. This change from the typical terete leaf is probably due to the moister situation.

Dillwynia uncinata (Turcz.) J. M. Black. Koonibba, near Fowler's Bay, *J. B. Cleland*. A new locality, connecting with the stations of this species in Western Australia.

**Robinia pseudacacia*, L. This handsome tree, sometimes called "Locust Tree," with drooping racemes of fragrant white flowers, has established itself along creeks in gullies of the Flinders Range, below the Wirrabara Forest, as an escape.—North America.

RUTACEAE.

Boronia Edwardsii, Benth. Gravelly hilltop near Mount Scrub, Hundred of Waitpinga, *J. B. Cleland*. Dwarf rigid shrubs, 10-20 cm. high, with the leaflets pubescent above.

Phebalium brachyphyllum, Benth. Fl. Aust. 1 : 341 (1863). Specimens from Warooka, Yorke Peninsula, are in flower and show that the pedicels are 3-4 mm. long, with 2 minute bracts below the middle, the calyx about 2 mm. long, with deltoid lobes, the petals linear-lanceolate, 5-6 mm. long, pink towards the tip, the leaves minutely scabrous; stamens about as long as petals (pl. x., fig. 2).

Mueller, in 1st Cens. 11 (1882) states that this is the same plant as *Eriostemon microphyllus*, F. v. M. in Trans. Philos. Soc. Vict. 1 : 99 (1855), a fact which Bentham seems to have overlooked. Mueller gives the habitat as "on the low coast ranges of Spencer's and St. Vincent Gulfs, but only rare." Bentham's name, however, stands in the genus *Phebalium* because of *Ph. microphyllum*, Turcz. (1852), a Western Australian species.

EUPHORBIACEAE.

Amperea spartioides, Brongn. Woodside, November, 1933, per J. E. L. Machell. Hitherto only recorded for the South-East.

MALVACEAE.

Sida virgata, Hook. var. *phaeotricha* (F. v. M.) Benth. Has a different appearance from the type on account of the much denser and looser stellate golden-brown tomentum, which is specially noticeable on the calyx and the pedicel down to the articulation where the latter joins the peduncle proper; calyx 5-6 mm. long; petals 7-8 mm. long and 8 mm. broad near the notched summit.—*S. phaeotricha*, F. v. M.

Ernabella and Erliwanjawanja, Musgrave Ranges, August, 1933, *J. B. Cleland;* west of Mount Kintore (near the Deering Hills), July, 1933, *Tindale and Hackett*. The variety appears to have been found hitherto only in our North-West, but it will probably be discovered in Central and Western Australia.

STERCULIACEAE.

Brachychiton Gregorii, F. v. M. South of Mann Range, July, 1933, *Tindale and Hackett*. "On mallee and porcupine plain, each tree growing from the heart

of a mallee clump; the seeds are an important food of the natives, who call the tree 'ngalta' and 'ngaltatjiti.' "

This is the first time specimens have been collected since the Elder Expedition passed through our Far North-West in 1891. All the leaves on our specimens have only 3 long narrow lobes, and are supported on filiform petioles $3\frac{1}{2}$-10 cm. long, but always shorter than the leaf; follicles coriaceous, brown, finally glabrous outside, ovoid, 2-$2\frac{1}{2}$ cm. long, villous inside, abruptly narrowed at base and with a sharp hooked beak at summit; seeds fallen; stipes 2-$3\frac{1}{2}$ cm. long. Probably the follicles are sometimes much larger, as Mueller describes those of the type, from the Murchison River, Western Australia, as 2 inches (5 cm.) long.

FRANKENIACEAE.

Frankenia uncinata, Sprague et Summerh., Minnie Downs, near Diamantina River, South Australia, August, 1931, *L. Reese.* Small greyish much-branched plant 10-15 cm. high; calyx 6-7 cm. long, with hooked hairs; the hairs on the stems and branches are usually straight; petals 9-12 mm. long, the lamina about 4 mm. broad; stigmas linear, $\frac{1}{2}$-1 mm. long; leaves 3-10 mm. long, with minute or gland-like hairs, the upper leaves linear or lanceolate, with revolute margins almost concealing the under-surface, some of the lower ones becoming glabrous above, almost flat, and about 3 mm. broad. The hairs on the calyx are sometimes only slightly hooked.

These specimens contain the leading characters of *F. uncinata* and *F. hamata,* Summerh., and I think these 2 species should be united under the first name, both being of the same date. Mr. Summerhayes, in his "Revision of the Australian species of Frankenia," Journ. Linn. Soc. 48 : 382 (1930) says:—"Further research may show that *F. hamata* is only a luxuriant form of *F. uncinata,* but at present the evidence is not sufficient."

MYRTACEAE.

Melaleuca linophylla, F. v. M. Musgrave Ranges, *J. B. Cleland.* This is a "paperbark" tea-tree.

Melaleuca monticola, nov. sp. Frutex cortice rugoso nigello; ramuli foliaque juvenilia pubescentia, demum plus minusve glabrescentia; folia alterna, lineari-lanceolata, 4-10 mm. longa, circa $1\frac{1}{2}$ mm. lata, acuta, sessilia, conferta, erecto-patentia, crassa, rigida subplana vel supra subconcava, glandulis translucidis immersis conspersa, 3-5-nervia; flores pauci, parvi, axillares, spicati vel fere glomerati; rhachis florifera pubescens; receptaculum cyathiforme, cinereum, parce pubescens, 2 mm. longum, sepala glabrescentia decidua aequans; petala alba, $1\frac{1}{2}$ mm. diam.; fasciculi staminales 9-12-andri, circa 3 mm. longi, filamentis albis, ungui quam petalum breviore; fructus brevissime cylindratus, late truncatus, circa 2 mm. longus, $2\frac{1}{2}$-3 mm. diam., apice haud vel vix angustatus (pl. x., fig. 1).

Near Ernabella, Musgrave Ranges, August, 1933, *J. B. Cleland;* Glen Ferdinand, July, 1914, *S. A. White.* A "black tea-tree," resembling *M. pubescens,* from which it differs in the sessile glandular-dotted leaves, the smaller and differently shaped flowers, and especially in the small squat fruit, broadly truncate and not or scarcely contracted at either end. The leaves of *M. pubescens* are supported on a short flat petiole, $\frac{1}{2}$-1 mm. long, and have no immersed transparent glandular dots as in this species.

Calythrix tetragona, Labill. A curious form was collected by Prof. Cleland in October, 1933, along the coast between Hallett's Cove and Port Noarlunga, the long awns of the sepals being entirely absent. Technically this peculiarity would place the plant in *Lhotzkya,* but it is certainly *C. tetragona*—the form with pubescent branchlets and glabrous tetragonous leaves 4-7 mm. long.

Eucalyptus Ewartiana, Maiden. A mallee, normally with striped deciduous bark; leaves thick, stiff, pale-green, broad-lanceolate, 5-9 cm. long, 2-2½ cm. broad, the nerves inconspicuous, the intramarginal one about 1 mm. from the edge; peduncle terete, 8-20 mm. long; umbel with 3-6 flowers on pedicels 2-3 mm. long; buds clavate, with small hemispherical cap; fruit depressed-globular, 9-11 mm. long, 12-13 mm. diam., the length including the broad exserted convex rim, but not the 4, rarely 3 deltoid exserted valves tipped by linear points about 4 mm. long, which soon break off, the rim conspicuous but shorter than the receptacle; fertile seeds ovoid-truncate, light-brown, about 3½ mm. long, 3-angled and narrowly winged on each angle.

Yeelunginna Hill (west of Everard Range), June 12, 1891, *R. Helms;* plain between Musgrave and Mann Ranges, June 29, 1933; north-west of Konamata (south of Mann Range), July 15, 1933, *Tindale and Hackett.* Also in Western Australia.

Helms's specimen is the type, described by Maiden in 1919.

Very near *E. Oldfieldii,* F. v. M., from which it differs in the fruit rather smaller and shortly pedicellate instead of subsessile, and perhaps also in the long erect fragile points of the valves, after the manner of *E. oleosa* and *E. incrassata* var. *protrusa.* These linear extensions of the valves are not mentioned by Maiden, probably because in the type specimen they were all broken off, leaving only the lower deltoid parts.

Eucalyptus dichromophloia, F. v. M. Specimens collected by Messrs. Tindale and Hackett between the Mann and Musgrave Ranges, South Australia, appear to belong to this species rather than to *E. terminalis.* They have very smooth, thin-skinned, urn-shaped fruits, smaller than those of *E. terminalis.*

Eucalyptus incrassata, Labill. var. *protrusa,* J. M. Black. Mr. A. Morris, of Broken Hill, when growing seedlings of this mallee, from specimens gathered near Whyalla, Eyre Peninsula, found that the cotyledons were broad and reniform in outline. The fruits, with their protruding valve-points, are so much like those of *E. oleosa* that specimens without buds have sometimes been classed as belonging to that species. The cotyledons are, however, like those of *E. incrassata* and very different from the narrow bisected or V-shaped cotyledons of *oleosa.* The operculum is, of course, quite distinct in the 2 species.

SOLANACEAE.

Of the 3 species of *Nicotiana* which I have grown in the garden—*N. excelsior, N. Gossei,* and *N. ingulba*—none have survived the first year, so that they may be annual, in spite of the robust appearance of the 2 first-named. On the other hand, Mr. H. Greaves, Director of the Botanic Garden, who first grew *N. ingulba,* tells me that he finds it at least biennial.

Solanum centrale, nov sp. Frutex omnino dense stellato-tomentellus; aculei graciles, in ramis petiolisque pauci et rari, in foliis nulli, in calycibus nulli vel rarissimi; folia crassa, velutina, 3-6 cm. longa, 1½-3 cm. lata, basi rotundata, integra, obtusa, supra fulva, infra viridella; petioli 5-18 mm. longi; flores nutantes in cymis corymbiformibus, pedunculatis, lateralibus; pedicelli 5-10 mm. longi; calyx 8-9 mm. longus, lobis lanceolatis obtusis, circa 5 mm. longis, sub fructu deltoideis; corolla purpurascens, circa 20 mm. longa, extus tomentella; antherae 8-9 mm. longae; inferior pars styli stellato-pilosa; bacca ovoidea, circa 15 mm. longa, 10-12 mm. diam., flava, edulis, 4-locularis (pl. xi., fig. 4).

Central Australia—Macdonald Downs Station, 1932, *Miss J. Chalmers.* Miss Chalmers says its name in the language of the Ilaura tribe is "akitjura," and adds:—"Berries bright yellow when ripe, egg-shaped; will keep well when dried; the natives eat them dry or mashed up in water."

Differs from *S. ellipticum* in the shorter and less subulate calyx-lobes, the style hairy in the lower half, instead of glabrous, the corymb-like cymes instead of long racemes and the usually smaller ovoid (not globular) fruit.

Solanum ellipticum, R. Br. has been found in Central Australia at Macdonald Downs by Miss J. Chalmers, and at Mount Liebig and Ya Ya Creek by Professor J. B. Cleland. The leaves are sometimes greener than in our southern specimens. Messrs. Tindale and Hackett, in a note to specimens from between the Mann and Musgrave Ranges, say the name in the eastern dialect is 'djurarupa," and in the western "koilpura," adding:—"Green fruit, about 15 mm. diam., with sweet tomato-like flavour, much eaten by natives." Miss Chalmers says the name in Ilaura is "albáringa" and describes the berry as "light-green when ripe and peeled by the natives before eating." Prof. Cleland gives the name as "randa" or "ranto" in the Aranda language, and "wandji" in Luritja. He adds:—"Fruit greyish-green and eaten when ripe."

Solanum quadriloculatum, F. v. M. A rather stout undershrub, with a dense soft greyish or greenish stellate tomentum; prickles slender, pale-yellow, usually rather numerous on the stems, scattered and caducous on calyxes, none on leaves or a few small ones near base of midrib below; leaves petiolate, entire, ovate-acute, thick, soft, 5-12 cm. long, 2½-6 cm. broad; flowers in lateral racemes on stout peduncles 4-9 cm. long; pedicels recurved, 5-10 mm. long; calyx 6-8 mm. long, the lobes unequal, linear-lanceolate, lengthening in fruit; corolla purplish, about 2 cm. diam. when open; style glabrous; berry globular, yellow, 12-18 mm. diam., 4-celled, becoming very hard, inedible.—*S. ellipticum* var. *duribaccalis,* J. M. Black in Trans. Roy. Soc. S. Aust. 52 : 227 (1828).

South Australia—Mount Lyndhurst, *Max Koch* (in Tate Herb.); Finniss Springs, *F. D. Warren.* Not previously recorded in our State.

Central Australia. Rumbalara railway station, Mount Liebig and Mount Hay, *J. B. Cleland;* Macdonald Downs, *Miss J. Chalmers;* near Lander River, *G. F. Hill.* Also in North Australia.

Miss Chalmers writes that the native name is "únduk-únduk." Of the fruit she says:—"Yellow in colour, round, the size of a marble, not eaten." Prof. Cleland says:—"Berry green, then yellow, not eaten."

Var. *mollibaccalis* and var. *duribaccalis,* described as varieties of *S. ellipticum,* l.c. supra (1828), must be deleted, as they were due to a mistaken determination of Max Koch's specimen.

The hard inedible fruit resembles that of *S. petrophilum,* but the leaves of the latter are sinuate-lobed, thinner, prickly, greener on the upper face and the calyx-lobes more conspicuously keeled.

S. eremophilum, F. v. M. Additional localities for South Australia are Murnpeowie and Tarcoola; for Central Australia Haast's Bluff, *J. B. Cleland;* Macdonald Downs, *Miss J. Chalmers.* The globular berry is about 12-15 mm. diam. and is at least half-enclosed in the more or less prickly calyx. Miss Chalmers says it is called "Wild Gooseberry" by the white residents and "mónúma" by the blacks in the Ilaura language. Of the fruit she writes:—"Size of a marble; has a pleasant smell and an excellent flavour." The fruiting peduncles are 4-7 cm. long, the fruiting pedicels 2-2½ cm. long.

Scrophulariaceae.

Stemodia viscosa, Roxb. This plant, recorded hitherto only from the Birksgate Range in our State, has been found by Prof. Cleland at a rockhole 8 miles north of Ernabella, in the Musgrave Ranges.

**Zaluzianskia divaricata* (Thunb.) Walp. Palmer (near Mannum), *M. T. Winkler.* A new locality for this small South African plant.

LABIATAE.

**Ajuga Iva*, Schreb. Dry paddock at Roseworthy Agricultural College, November, 1933, *G. H. Clarke.* Mediterranean region.

RUBIACEAE.

Plectronia latifolia (F. v. M.) Benth. et Hook. Camp 16, Kanpi, south side of Mann Range, July 14, 1933, *Tindale and Hackett.* The short calyx-teeth are more often 4 than 5.

CUCURBITACEAE.

Cucumis Chate, Hasselq. (*C. Melo.* L. var. *agrestis,* Naud.) Pandi Pandi, on Diamantina River, September, 1934, *J. B. Cleland.* The fruit is eaten by the natives after the hairs have been rubbed off.

CAMPANULACEAE.

Wahlenbergia.

Mr. N. E. Brown, in the Gardener's Chronicle 54 : 316, 336 and 354 (1913) reviewed the Australian and New Zealand species of this genus and described 4 of them at length. It is certainly unsatisfactory to place plants so different in many of their characters under *W. gracilis,* A. DC., as was done by Bentham in Fl. Aust. The filaments, and probably the anthers, show divergencies in form which have taxonomic value. The anthers are very fugitive and are often difficult to find in dried specimens; the filaments, rising at the summit of the receptacle and surrounding the base of the style, consist of a linear or linear-lanceolate part of varying length which supports the anther and which is expanded towards the base into a flat 2-winged usually ciliate or fringed hyaline part.

Much critical work remains to be done, especially on living specimens, but the following is an attempt, based on N. E. Brown's valuable paper, to distinguish our South Australian species:—

A. Perennials; filaments dilated abruptly into 2 broad wings at base; sepals and corolla-lobes 5; leaves to 5 cm. long.
  B. Lower leaves to 8 mm. broad, mostly linear-oblong or oblanceolate.
    C. Sepals longer than receptacle, very narrow; corolla 15-28 mm. long .. .. *W. vinciflora* 1
    C. Sepals equalling receptacle; corolla 10-12 mm. long .. *W. Sieberi* 2
  B. All leaves narrow-linear; sepals slightly exceeding receptacle; corolla about 12 mm. long .. .. *W. multicaulis* 3
A. Annual; filaments gradually dilated downwards into 2 narrow wings; sepals and corolla-lobes 4-5; leaves mostly lanceolate or ovate, $\frac{1}{2}$-2 cm. long .. .. *W. quadrifida* 4

1. *W. vinciflora* (Vent.) Decaisne in Rev. Hort. p. 41 (1849). Perennial, almost glabrous or with short spreading hairs near base; stems erect, 20-45 cm. high, branching dichotomously, rarely simple and 1-flowered; leaves mostly alternate and on lower half of plant, the lower ones linear-oblong, acute, glabrous or hairy, sessile, half-clasping, undulate and sometimes minutely toothed, 1-5 cm. long, 2-8 mm. broad, the uppermost leaves or bracts linear-lanceolate or narrow-linear; peduncles 3-20 cm. long; receptacle glabrous, $3\frac{1}{2}$-$4\frac{1}{2}$ mm. long in flower, 6-10 mm. long, ovoid-oblong or obconical in fruit; sepals 5, 5-20 mm. long, narrow-linear, acute, glabrous; corolla dark- to light-blue or almost white, 15-28 mm. long, exceeding the sepals, the spreading lobes about as long as the tube; anthers much longer than filaments, which are abruptly dilated into a truncate fringed base; style pubescent in upper part.—*W. gracilis,* Benth. Fl. Aust. 4 : 137 (1869) partly; J. M. Black Fl. S.A. 546, fig. 239, A, D, C (1924);

Campanula vincaeflora, Vent. Jard. Malm. t. 12 (1803); *C. gracilis,* Bot. Mag. t. 691 non Forster.

Brighton; Mount Lofty Range; Berri; Murray Bridge; Ardrossan, Yorke Peninsula; Hamilton; Spalding; Booleroo; Yunta; Hawker; Minnie Downs (near Diamantina River); Hamilton Bore, Arkaringa Creek. Eastern States and Western Australia.

This is the handsome "Australian Bluebell," distinguished by its large flowers and comparatively long very narrow sepals.

Nov. var. **rosulata.** Folia fere omnia basilaria, 2-5 mm. lata, glabra vel pilosa, superioribus setaceis ad basin ramorum sitis; sepala 6 mm. longa.

Gladstone; Quorn.

2. *W. Sieberi,* A. DC. Monogr. Camp. 144 (1830). Perennial; stems erect or ascending, branching, 10-60 cm. long, scabrous with short hairs near base; leaves 1-5 cm. long, $1\frac{1}{2}$-8 mm. broad, undulate with white cartilaginous margins, entire or distantly denticulate, usually scabrous, with short spreading hairs, the lower ones crowded towards base of stems, oblanceolate or obovate, acute or obtuse, tapering into a flat hairy petiole, the upper ones linear-lanceolate, sessile, distant, mostly glabrous; peduncles 2-8 cm. long; receptacle 3-4 mm. long, glabrous, in fruit ovoid and 6 mm. long; sepals 5, about the same length, narrow; corolla blue, 10-12 mm. long, the tube about as long as the acute lobes; anthers longer than filaments, which are abruptly dilated into a broad ciliate base; style almost glabrous, 3-lobed.

Minnie Downs; Strzelecki Creek; Finniss Springs (near Lake Eyre). New South Wales. Central Australia—Alice Springs.

3. *W. multicaulis,* Benth. in Hueg. Enum. 75 (1837). Perennial, glabrous or almost so; stems slender, erect, numerous, usually branching, rarely simple and 1-flowered, 10-40 cm. high; leaves all narrow-linear, the lower ones usually opposite, $\frac{1}{2}$-5 cm. long, about 1 mm. or less broad; peduncles filiform, 2-7 cm. long; receptacle 3-4 mm. long, in fruit 5 mm. long and obconical; sepals 5, 3-5 mm. long, very narrow; corolla blue, about 12 mm. long, the acute lobes longer than the tube; anthers longer than filaments, which are abruptly dilated into a broad ciliate sometimes 3-lobed base; style 3-lobed, pubescent in upper part.

Lefevre's Peninsula; Glenelg; Myponga; Murray Lands; Overland Corner; Telowie Gorge and Hundred of Howe (Flinders Range), Koonamore; Lake Callabonna; Bordertown; Maitland, Yorke Peninsula; Bookabie, Eyre Peninsula. Eastern States. Western Australia.

4. *W. quadrifida* (R. Br.) A. DC. Monogr. Camp. 144 (1830). Annual; stems slender, erect or ascending, 4-20 cm. long, branching or simple and 1-flowered, beset with short spreading or deflexed hairs in all their length or only near base; leaves opposite or alternate, oblong, oblanceolate, ovate or obovate, 3-20 mm. long, 2-9 mm. broad, undulate with white cartilaginous margins, the lowest, or sometimes also the upper ones, scabrous with short spreading hairs, the uppermost lanceolate or linear-lanceolate; peduncles 1-8 cm. long; receptacle 2-3 mm. long, glabrous or with short spreading hairs, in fruit ovoid or almost globular, 3-5 mm. long; sepals 4-5, comparatively broad, 2 mm. long; corolla blue or white, 4-5-lobed, about 4-6 mm. long; anthers equalling or slightly shorter than filaments, which are gradually dilated downwards into 2 narrow ciliolate wings; style pubescent, 2-3-lobed.—*Campanula quadrifido,* R. Br. (1810); *W. gracilis,* Benth. partly, not of Forster; J. M. Black Fl. S.A. 546, fig. 239B (1924).

Waterfall Gully; Marino; Munno Para; Murray lands; Wellington; Spalding; Jamestown; Wirrabara, Moolooloo, Beltana, Mount Parry (Flinders Range); Ardrossan, Yorke Peninsula; Fowler's Bay; Lake Callabonna. New South Wales. The type came from near Port Jackson.

W. gracilis (Forst.) Schrader in Blumenbachia 38 (1827), A. DC. and Benth. partly, was described as *Campanula gracilis* from specimens collected by Forster in New Zealand and New Caledonia, and, according to N. E. Brown, it is doubtful whether it has been found in Australia.

Cephalostigma fluminale, nov. sp. Planta perennis omnino glabra; caules graciles, flexiles, ut videtur volubiles, 50-60 cm. longi, dichotome ramosi; folia fere nulla, superiora ad parvas bracteas pedunculos suffulcientes redacta; pedunculi 1-flori, capillares, flexiles, 3-8 cm. longi, laxissime paniculati; receptaculum floriferum 2 mm. longum, fructiferum ovoideum, 4 mm. longum; sepala 5, lanceolata, 2 mm. longa; corolla caerulea, profunde 5-lobata, circa 8 mm. longa, rotata, lobis basin versus attenuatis, tubo brevissimo; filamenta in basin latam subito dilatata; stylus ad aspectum capitatus, lobis 3 latis, brevibus; capsula apice tribus valvis dehiscens; semina oblongo-elliptica, fere plana, $\frac{1}{2}$ mm. longa (pl. xi., fig. 1).

I have only one specimen, collected on the River Murray (without exact locality) in December, 1913, by Capt. S. A. White.

Cephalostigma, A. DC., differs from *Wahlenbergia* in the deeply 5-lobed and rotate corolla and in the broadly 3-lobed style. The genus inhabits Asia, tropical Africa and Brazil, and this appears to be the only known Australian species.

COMPOSITAE.

**Crepis taraxacifolia,* Thuill. Differs from *C. virens,* L. by the achenes all tapering into long beaks, the radical leaves pubescent, lyrate with broad-toothed lobes, the lower lobes small and distant, the stem-leaves smaller, few and clasping by auricles; involucre 10 mm. long and surpassed by the white pappus at maturity.

South-East, October, 1933, per A. G. Edquist. First record for South Australia, but Professor Ewart records it as common in Victoria since 1906.—Central and Southern Europe.

**Achillea Millefolium,* L. "Milfoil" or "Yarrow." This appears to be the species growing in our southern districts, and not *A. tanacetifolia,* All., as given in Fl. S.A. 605. It is sometimes almost woolly. The flowers may be white or purplish-red. The whole leaf is somewhat concave above, the segments not lying in the same plane, and being slightly curved upwards; the rhachis is not toothed. —All over Europe.

**Centaurea pratensis,* Thuill. Sevenhills, on uncultivated land around a currant-drying shed. February, 1934, *Worsley C. Johnston.*—Central Europe; not previously recorded here.

Wedelia verbesinoides (F. v. M. herb.) Benth. Fl. Aust. 3 : 538 (1866). Erect plant, 30-60 cm. high, scabrous all over with short rigid appressed tubercle-seated hairs; stems rigid, branching; leaves opposite, lanceolate, usually acute, 2-8 cm. long, 4-20 mm. broad, rigid, concave above, narrowed at both ends with 1-3 prominent distant teeth on each margin; peduncles solitary, terminal, 3-16 cm. long; involucre hemispherical, 4-5 mm. long, the bracts ovate-oblong, acute, in about 2 rows; receptacle convex, with broad boat-shaped scabrous keeled scales enclosing the flowers; ray-flowers female, 8-12, the ligules obovate-oblong, yellow, notched, 8-10 mm. long; disk-flowers bisexual, tubular, 5-toothed; style-branches surmounted by a short conical appendage; achenes 3-4 mm. long, black, compressed or subtrigonous, narrowly 2-winged, each wing excurrent upwards in a short blunt or acute appendage; pappus a minute denticulate cup or crown sometimes produced into 1 or 2 bristles (pl. x., fig. 6).—*W. Stirlingii,* Tate in Horn Exped. 3 : 188 (1896).

Mount Crombie (south-west of Musgrave Ranges), July, 1933, *Tindale and Hackett;* Ernabella (Musgrave Ranges), August, 1933, *J. B. Cleland.* Also in Central and North Australia. Not previously found in our State.

The genus *Wedelia*, Jacq. is distinguished from *Eclipta* chiefly by the broad keeled concave scales of the receptacle, while those of *Eclipta* are narrow-linear and do not enclose the flowers; the style-branches of *Wedelia* are appendaged above the stigmatic lines, while those of *Eclipta* are merely truncate.

The only important difference between *W. Stirlingii* and *W. verbesinoides* is that the heads of the latter are described by Bentham as short-peduncled. Mueller himself accepted specimens from Central Australia with long peduncles as *W. verbesinoides*.

Pterocaulon glandulosum, Benth. et Hook. var. *velutinum*, Ewart et Davies. Rockhole, 8 miles north of Ernabella, Musgrave Ranges, August 16, 1933, *J. B. Cleland*. In the single specimen collected the decurrent wings of the lower stem-leaves are entire, not toothed.—Central Australia.

Basedowia tenerrima (F. v. M.) J. M. Black. Rockhole, 8 miles north of Ernabella, Musgrave Ranges, August 16, 1933, *J. B. Cleland*. The specimens are complete and show a slender plant, 5-10 cm. high, the stem branching from base; the leaves 8-25 mm. long by 3-7 mm. broad, 1-nerved, reticulate. The sparse clothing, chiefly noticeable on the stems and the margins of the leaves, consists of rather long loose septate hairs. The heads contain only young buds.

Pluchea dentex, R. Br. Differs from *P. rubelliflora* in the leaves not decurrent in wings and with narrow distant conspicuous spreading teeth, which are 1-7 mm. long. Some of them are usually longer than the breadth of the leaf, which varies from 1-4 mm. The peduncles are longer (½-30 cm. long), the heads larger, the inner involucral bracts 5-6 mm. long and the disk-flowers 20-25 (pl. x., fig. 3).—*P. rubelliflora* var. *major*, J. M. Black, Fl. S.A. 626, not of Bentham.

Leigh's Creek, *R. Tate;* Everard and Birksgate Ranges, *R. Helms;* Ernabella (Musgrave Ranges) *J. B. Cleland*.—Central Australia; Queensland.

The true *P. rubelliflora* var. *major*, Benth. judging from authentic specimens lent by the Victorian National Herbarium, differs from the type only in the involucral bracts 6-7 mm. long, having the same comparatively broad, more or less decurrent, inconspicuously toothed leaves.

DESCRIPTION OF PLATES.

Plate X.

Fig. 1. *Melaleuca monticola:*—*A*, fruit; *B*, receptacle and sepals; *C*, petal.
Fig. 2. *Phebalium brachyphyllum:*—*D*, pistil and stamen.
Fig. 3. *Pluchea dentex:*—two leaves.
Fig. 4. *Tetraria monocarpa:*—spikelet; *E*, nut.
Fig. 5. *Tetraria capillaris:*—spikelet; *F*, two uppermost glumes with fertile flower, the sterile flower below them.
Fig. 6. *Wedelia verbesinoides:*—*G*, ray-flower; *H*, disk-flower; *I*, style; *J*, two scales of receptacle; *K*, two achenes.
Fig. 7. *Schoenus deformis:*—*L*, spikelet after the 2 supporting bracts have been removed; *M*, flexuose rhachilla; *N*, nut and hypogynous bristles.
Fig. 8. *Chenopodium pumilio:*—fruiting perianth; *O*, vertical section of fruit.
Fig. 9. *Chenopodium carinatum:*—fruiting perianth after one of Aellen's figures.
Fig. 10. *Chenopodium cristatum:*—one of the ripe perianth-segments.
Fig. 11. *Chenopodium melanocarpum:*—fruiting perianth.
Fig. 12. *Chenopodium atriplicinum:*—fruiting perianth.
Fig. 13. *Chenopodium rhadinostachyum:*—fruiting perianth.
Fig. 14. *Chenopodium plantaginellum:*—fruiting perianth.
Fig. 15. *Chenopodium simulans:*—*P*, plant, drawn from the type-specimen in the Victorian National Herbarium; *Q*, fruiting perianth.
Fig. 16. *Chenopodium myriocephalum:*—*R*, perianth-segment and fruit.
Fig. 17. *Chenopodium Blackianum:*—*S*, perianth of 3 segments; *T*, two fruits.

PLATE XI.

Fig. 1. *Cephalostigma fluminale:*—*A,* receptacle, sepals and style; *B,* summit of capsule opening in 3 valves; *C,* seed; *D,* flower.

Fig. 2. *Sarcozona Pulleinei:*—*l,* lamina of 1 of the 2 involucral bracts; *p,* body of perianth, free but enclosed in the sheath; *sh,* sheath of the 2 bracts, bisected vertically; *o, o,* 2 outer lobes of perianth; *i,* one of the 2 inner lobes.

Fig. 3. *Calostemma purpureum:E,* flower spread open; *F,* fruit cut vertically, sprouting on April 20, 1932; *G,* a similar fruit, on May 6; *H,* same, on May 22; *I,* a dicotyledonous fruit on August 21; *J,* one of the same plants, on September 15, 1934, *i.e.,* nearly 2½ years old; c^1, first cotyledon; c^2, second cotyledon; c^3, third cotyledon; *st,* scar of style; *p,* scar of pedicel; *pl,* plumular leaf; *r,* radicle; *sh,* sheath of cotyledon, becoming the outer coat of the bulb; *fr,* withering fruit.

Fig. 4. *Solanum centrale:*—*K,* ovary and style; *L,* fruit; *M,* transverse section of fruit.

THE MUNYALLINA BEDS. A LATE-PROTEROZOIC FORMATION.

BY D. MAWSON, K.B., D.SC., F.R.S.

Summary

The beds described herewith occupy a basin, elongated in a N.E.-S.W. direction, in the eastern foothills of the main Flinders Range in the latitude of Lake Frome. Reference to the physiography of the area has been published by Dr. W. G. Woolnough(1). A striking ridgeline joining Mount Chambers, Nepouie Peak and Mount Jacob overlooks the Lake Frome Basin thereabouts and outlines the eastern margin of the belt. Following Dr. Woolnough's nomenclature, this feature may be distinguished as the Nepouie Rampart. Under this Rampart lies the Balcanoona Station homestead to the south and the Wooltana Station homestead to the north. Westward of the Nepouie Rampart lies a depressed region, a large portion of which is drained by the Munyallina Creek. The basin of the Munyallina Creek is occupied by the beds now to be described, hence the designation "Munyallina beds." However, the upper portion of the series extends beyond the basin of the Munyallina Creek into areas drained by the Arkaroola Creek and the Bolla Bollana Creek.

THE MUNYALLINA BEDS. A LATE-PROTEROZOIC FORMATION.

By D. Mawson, K.B., D.Sc., F.R.S.

[Read October 11, 1934.]

Introductory Notes.

The beds described herewith occupy a basin, elongated in a N.E.-S.W. direction, in the eastern foothills of the main Flinders Range in the latitude of Lake Frome. Reference to the physiography of the area has been published by Dr. W. G. Woolnough (1). A striking ridge line joining Mount Chambers, Nepouie Peak and Mount Jacob overlooks the Lake Frome Basin thereabouts and outlines the eastern margin of the belt. Following Dr. Woolnough's nomenclature, this feature may be distinguished as the Nepouie Rampart. Under this Rampart lies the Balcanoona Station homestead to the south and the Wooltana Station homestead to the north. Westward of the Nepouie Rampart lies a depressed region, a large portion of which is drained by the Munyallina Creek. The basin of the Munyallina Creek is occupied by the beds now to be described, hence the designation "Munyallina beds." However, the upper portion of the series extends beyond the basin of the Munyallina Creek into areas drained by the Arkaroola Creek and the Bolla Bollana Creek.

The Munyallina beds extend north-west towards the Bolla Bollana Creek, in the neighbourhood of which they contact with older sedimentary formations, partly along an unconformable junction and elsewhere, it is inferred, along a fault line. I have had scant opportunity of observing the north-western margin of the basin, and information relating thereto is still incomplete.

In the year 1910, at the time of our discovery of radium-bearing minerals of the Mount Painter belt, I penetrated to the Bolla Bollana Creek crossing the Flinders Range from the north, *via* Mount Painter. Then, when reconnoitring along a tributary on the south side of the Bolla Bollana Creek, tillite was discovered dipping to the south-east and overlying unconformably old sediments with which was noted an association of amygdaloidal, basic, volcanic rocks. The tillite was observed to form the base of a series extending towards Wooltana Station. A short note (2) was then published referring briefly to the geology of the Mount Painter region. Subsequently some of the volcanic rocks collected at that time were described. (3)

In 1924 an opportunity arose for again visiting the Flinders Range in that locality. On that occasion most of the time was spent examining the Archaeozoic rocks of the central Mount Painter belt, but in company with A. R. Alderman and R. G. Thomas a trek, with camels transporting our baggage, was made into the Flinders Range on the east side at several points in the neighbourhood of Wooltana and Paralana. One line of traverse took us north-west from Wooltana Station *via* the north side of Mount Warren Hastings to the Bolla Bollana Creek, then *via* the Radium Creek to Mount Painter. The remarkable occurrence of volcanic rocks at Wooltana was recorded in a subsequent publication (4), but the stratigraphy of the overlying sedimentary series was deemed sufficiently important to warrant further detailed investigation. In the meantime Dr. Woolnough, who had visited the Wooltana area in 1923 or 1924, published a paper (1) on the geology of the locality; at the time he was evidently not aware that I had contributed notes on the same area a few months previously.

My opportunity for further observation came in 1929, when, in company with several students, a further reconnaissance of the Wooltana area was effected. On that occasion the line of the present section was traversed in detail, but time would not allow of any extended areal work. Fortunately, along the line of section the beds appear to be little disturbed by dislocation or folding. Thus, though the observations were principally confined to a single line of traverse, it is likely that the section herewith is fairly accurately delineated. The only location in the section where it has appeared possible that a dislocation of any magnitude may exist is immediately below the Cave Hill limestone (No. 11) but Dr. Woolnough's account has no regard for such; hence the view that the section as detailed is correct gains confidence.

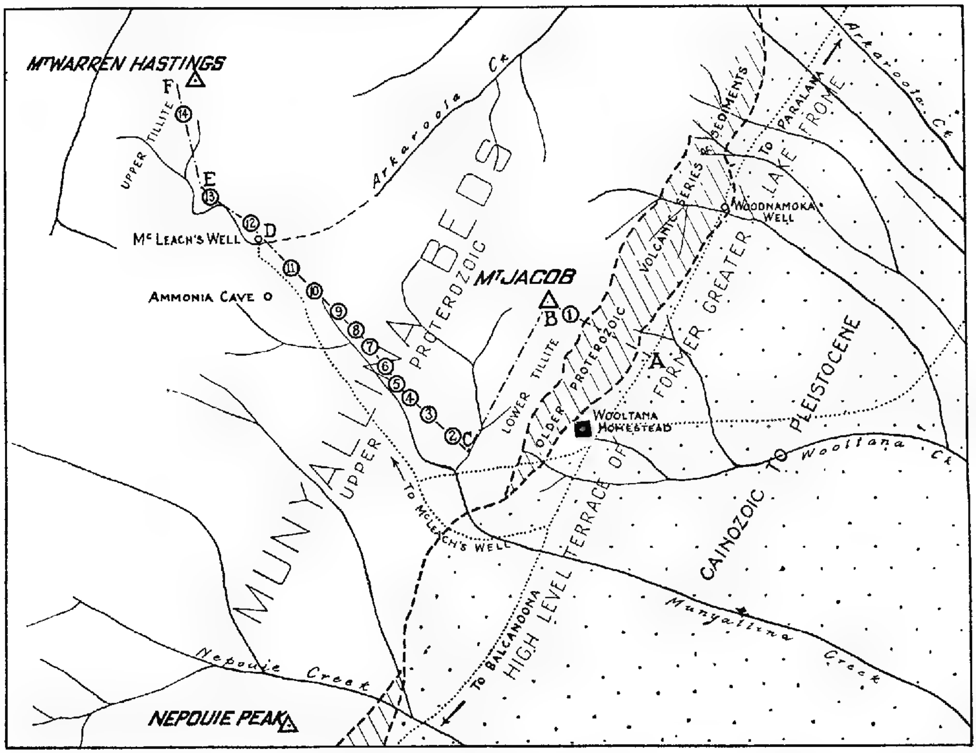


Fig. 1—Locality Map.

The dotted lines represent tracks, while the boundaries of the geological formations are shown by broken lines.

In describing the beds, they will be dealt with in certain convenient groupings, arranged in ascending sequence. The lowest beds figured underlie the lower glacial horizon, and are not included with the Munyallina beds, for the evidence seems to point to a break at the base of the glacial horizon. The question of a time break at this horizon is, however, a feature difficult to determine when judged only on the evidence presented in the escarpment at Wooltana; since, in any case, one is there faced with abnormal circumstances introduced by the onslaught of an ice age immediately superimposed upon extraordinary events arising from an outburst of volcanic activity at the very spot. Those underlying beds include a sedimentary series and volcanic contributions including ash beds, melaphyre and other basic lavas. The latter are intercalated in the sediments

immediately below the Munyallina beds. Interesting details of the occurrence are recorded by Dr. Woolnough (1). The sediments comprise not only arenaceous and argillaceous members, but also dolomites and dolomitic limestones are strongly in evidence. They doubtless correspond with some of the lower members of the Adelaide Series of the southern portions of the State.

Eastward of the Nepouie Rampart, these older beds pass under horizontally-laid Cainozoic and Pleistocene sandstone and gravel beds which constitute a high-level lake terrace of the former greater Lake Frome. These lake terrace beds also obscure the Cretaceous formations of the artesian basin which underlie the Lake Frome basin.

Descriptive Details of the Munyallina Beds.

The Munyallina beds will now be described, commencing at the base.

1. A glacial and fluvio-glacial formation. This is constituted mainly of boulder beds, most of which are definite tillites. Also included are coarse pebbly and gritty quartzites in which current bedding is well defined. Bands of finer and more even-grained quartzite have been noted.

Near the base the boulders in this series are dominantly basic lava types of the underlying formation. Also there are present quite large blocks, up to 3 ft. in diameter, of the buff-coloured dolomitic limestone of the older sediments. A couple of hundred feet above the base of the series, the boulders of limestone and of basic lavas become a minor feature owing to increasing abundance of other types, including quartzite, pink granite and quartz-porphyry. Whilst some of these beds are definitely water sorted, others are devoid of bedding and composed of pebbles with a subdued rounded and faceted form, set in a rather sandy matrix, and are obviously glacially transported and accumulated. Dr. Woolnough records (1) finding several pebbles exhibiting typical glacial striae. He also reports, in his traverse immediately west of the Wooltana homestead, meeting quartzite erratics up to 3 ft. 6 in. long and a vitreous quartz erratic as much as 9 ft. in length.

The outcrop of these beds on the steep east face of Mount Jacob attains a thickness of about 400 feet. But overlying formations of the same general character continue across the strike of a belt of country to the west of Mount Jacob, indicating a considerable additional thickness which, however, has not been definitely determined. The actual line of section which forms the subject of this paper was run from the vicinity of Mount Warren Hastings through McLeach's Well to meet the belt of Mount Jacob conglomerates at a point about 3 miles south-west by south of Mount Jacob. At that point the conglomerate series is not less than 600 feet thick and dips about 20° to the west. The average direction of strike must be approximately N.E. to S.W. (true), since this conglomerate belt is seen to be making across the country from Mount Jacob to Mount McCallum, some 9 miles to the S.W. Directions of strike actually measured in the traverse of the section ranged between N. 45° E. true near the base at Mount Jacob to only N. 5° E. locally recorded in some of the upper sections.

The upper beds of this basal boulder series at the point on the line of section, where they are overlain by fine laminated slates, contain boulders up to 4 ft. in length. Quartzites predominate, but porphyritic andesitic and acid igneous rocks as well as large blocks of scoriaceous forms of basic lavas also appear. The total thickness of this division may be taken tentatively as 1,000 ft., it is certainly not less than 600 ft. and, on the other hand, may possibly exceed 1,000 ft.

2. Next in order above the glacial and fluvio-glacial conglomerates comes a thick series of laminated slate extending across about a half-mile of outcrop.

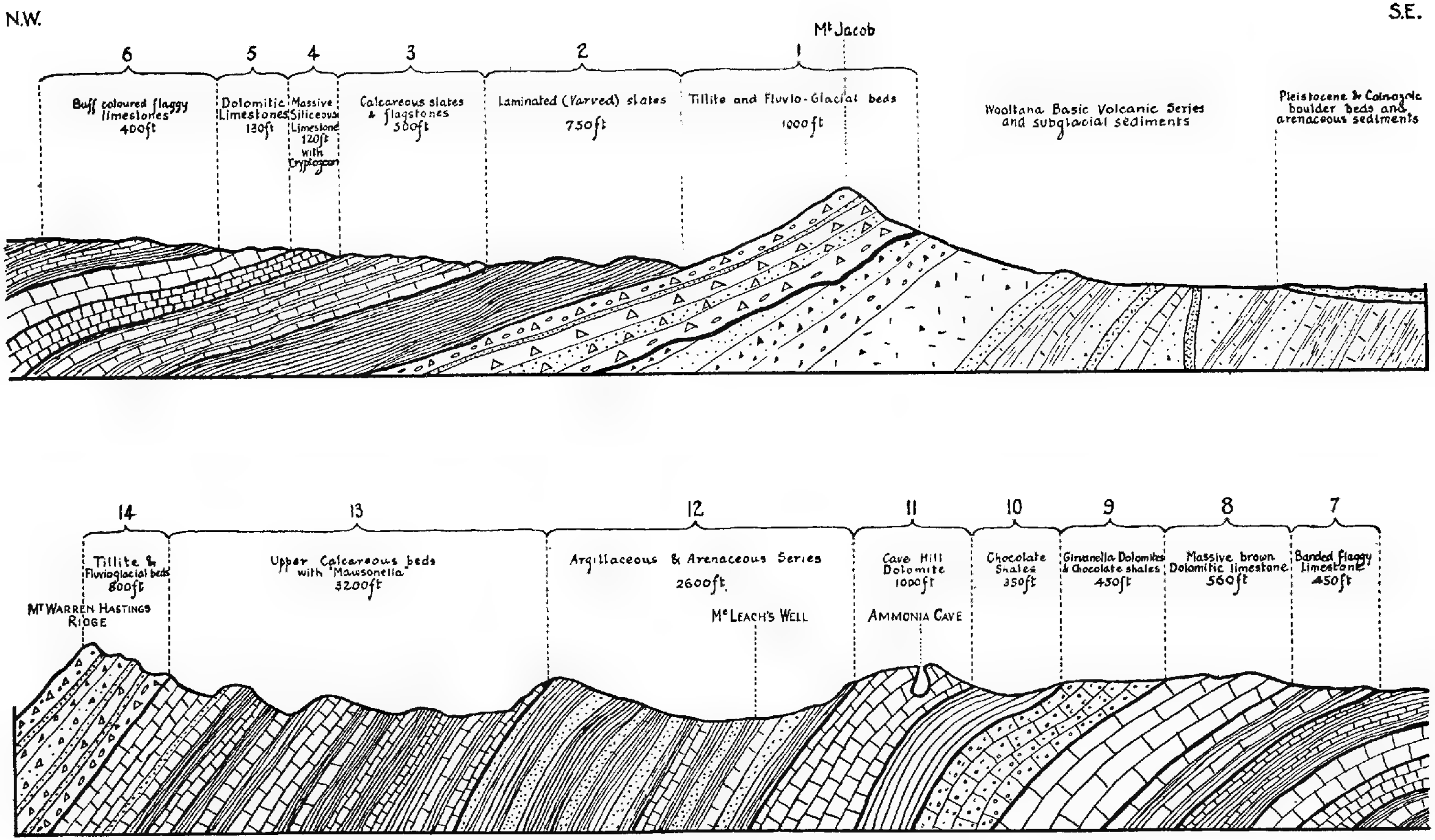


Fig. 2. Cross section of the Munyallina Beds on the line of section A B C D E F (Fig. 1).
The true thickness of each of the beds is stated.

The dip averages about 17° to the north-west. The true thickness is estimated at about 750 feet. Much of the outcrop exhibits a grey-green colour. The rock is of a rather soft nature and but little modified by recrystallization. There is evidence of a gradually increasing content of lime as one passes from the lower to the upper horizons. Cleavage ordinarily takes place along the bedding. The laminations, which are coarse in the lower portions of the beds, become very fine and poorly marked at the upper limit. Towards the base sandy bands are a feature, the character being that of a varved lamination. The sandy bands of the latter usually range between $\frac{1}{4}$ and $\frac{1}{2}$ inch in thickness, but a thickness as much as 4 inches was recorded. A large part of the series resembles Tapley's Hill slate of the neighbourhood of Adelaide.

On some of the bedding planes curious markings are to be observed. These may be fucoid trails or impressions of gelatinous organisms, or of inorganic origin.

3. Calcareous slates below leading upward to flaggy limestones with vermiculate structure. The average dip may be taken as about 15 degrees and the total thickness of the section about 500 feet.

The lower 130 feet consists of slates with thin calcareous bands exhibiting vermiculate structure. Then comes 220 feet of definite limestone bands, alternating with sandy shales leading upwards to a sandy, flaggy limestone. Finally the upper 150 feet is composed of a flaggy limestone with vermiculate markings, best illustrated in the topmost beds.

Intersecting the beds of this division is a reef 4 feet wide, composed at the outcrop of quartz and iron oxide; below the weathered zone this is doubtless a pyritic quartz reef.

4. Massive siliceous limestone pervaded throughout by traceries suggesting indistinct fossil markings. Near the top some patches less affected by recrystallization exhibit distinct cryptozoön structure of the Collenia type, first met with in Australian strata by Dr. C. Chewings (5). The dip is to the N.W. and amounts to only 10 or 12 degrees. The true thickness of this limestone is reckoned at about 120 feet.

5. Calcareous strata dipping about 10 degrees to the N.W. Much of this is a yellow dolomitic limestone, on the weathered face of which some queer but indefinite markings can be traced. Total thickness, about 130 feet.

6. A flaggy limestone series of a buff colour with an average dip of about 15 degrees. The total thickness is about 400 feet. Strike, about N. 41° E. true.

7. Banded flaggy limestones of a total thickness of about 450 feet. The dip is to the west, averaging about 23 degrees. In its lower portion it is a flaggy limestone with occasional bands of calcareous sandstone up to 12 inches wide. Towards the upper limit the limestone bands alternate with slate bands. Rising in the series, a chocolate colour becomes more and more marked, both in the limestone and in the argillaceous bands. The beds are notably jointed. Ripple marks appear and miniature current bedding is to be observed. On the weathered surfaces of the limestone queer, indefinite markings are frequently exhibited.

8. Massive chocolate to brownish-coloured limestone in which oolitic structure is abundantly developed. The dip is about 20 degrees to the west and the total thickness is about 560 feet. Most of this limestone is pervaded with a faint and indefinite pattern like that of the lower limestone of section (4) described above. The upper 100 feet is a hard, coarse, siliceous brown limestone.

9. Girvanella-bearing dolomitic limestones with some chocolate shale bands. The dip is to the west at about 20 degrees, and the total thickness some 450 feet.

The lower beds for about 100 feet in thickness are yellow, coarsely oolitic, dolomitic limestones with alternating chocolate shale bands. At the top of this section the spheroidal structures are developed to a truly remarkable degree, where each spherule attains a diameter of half an inch. In microscope section they exhibit typical Girvanella structure.

Further up, in the same division, the calcareous formations become nearly exclusively developed, resulting in a more massive, dolomitic limestone formation. In this, diminutive cryptozoön forms are notable in places. Another remarkable feature which appears in certain bands in this horizon is what was entered in the field notes under the descriptive term "bacon and egg structure." The latter refers to jumbled aggregates of coarse Girvanella spheroids associated with stromatoliths developed in curvilinear strips. The topmost limestone of this section exhibits still another kind of marking of intricate structure recorded in field notes as "brain structure."

10. Chocolate shales. These follow the Girvanella horizon. Where traversed the lower beds dip at about 20 degrees, but flatten out at the upper limit under the Cave Hill dolomitic limestone. Accordingly an estimate of the thickness is rendered more difficult. After due consideration of the data recorded, a thickness of 350 feet is assigned to these beds. They are not severely indurated and tend to cleave along the bedding planes.

11. Massive dolomitic marble with no obvious fossil markings. The dip throughout most of this belt is difficult to ascertain; consequently its thickness could not be accurately estimated. The average dip appears to be about 40 degrees, still directed down to the N.W. On this basis the thickness is in the neighbourhood of 1,000 feet.

It is in this formation that the "ammonia cave" is situated. There, in a deep cave eroded in the dolomite, is an extensive deposit, largely granular gypsum, but moderately rich in ammonium sulphate and chloride. This material, which is genetically connected with accumulations of bat guano, has been exploited commercially as a fertilizer (7).

12. Next comes a belt composed dominantly of arenaceous and argillaceous beds measuring in all about 2,700 feet in thickness. The dip is fairly uniformly to the N.W. at an average angle of about 40 degrees. The lower third consists of sandy and slaty beds with some minor limestone bands. The upper section is chiefly constituted of grey slates alternating with sand rocks of which much is a gritty quartzite. McLeach's Well, where potable water can be got, is situated in a dry creek bed at about one-third of the way west across this outcrop.

At about a quarter of a mile west of McLeach's Well some unexplained markings appear in the slates. At first sight, as seen on the cleavage faces, they recall graptolite markings, but on further inspection are seen to penetrate the body of the stone and may be of inorganic origin; consequently they remain problematical. Ripple marks and other features suggest shallow water deposition for at least a part of these beds.

13. About 3,200 feet of an upper calcareous series with "Mawsonella." The dip of this section averages about 40 degrees. The lower 600 feet is a belt in which there is an alternation of argillaceous bands and calcareous bands each ranging from a few inches to a few feet in thickness. The limestones are loaded with small, light-coloured particles which, from an investigation of some loose blocks picked up by me in the creek at McLeach's Well when on the 1924 visit, have been described by F. Chapman (6) as fragments of a calcareous alga and named Mawsonella. In some of the beds the Mawsonella appears as quite large pellets, becoming in some bands so coarse as to resemble in mass an inter-

formational limestone conglomerate. In any particular band the Mawsonella particles are usually roughly of equal size. In this same belt much black chert in nodular and banded form is distributed through the limestone.

Next in order, ascending in the series, comes a belt of slate in which are cavities formerly occupied by crystals of cuboidal or octahedral form. Only cavities remain in the specimen collected; thus the nature of the original mineral is doubtful. What may be expansion cracks run out into the slate from the corners of the crystal moulds. This slate band being harder than the limestones, tends to form a moderately pronounced ridge line in the local topography.

Next overlying is a very thick series of bluish-grey Mawsonella limestone alternating with slate bands. Then comes a 10-ft. band of quartzite. Finally there is a formation about 850 feet thick, principally composed of massive grey limestone with phyllitic bands.

14. An upper glacial and fluvio-glacial series. This striking glacial series follows upon the upper limestone belt without a stratigraphical break. The dip is still steep, about 45 degrees.

When I crossed the horizon in 1924, on the trek from McLeach's Well to Mount Painter, time did not permit of our recording detailed measurements. It was noted merely that we crossed massive glacial conglomerate beds before descending a steep slope leading to a tributary stream of the Bolla Bollana Creek. In 1929 two student members of the party, J. O. G. Glastonbury and F. J. Semmens, were detailed to traverse the beds west of the Mawsonella limestones as far as the Mount Warren Hastings ridge. Their observations are included herein.

Unfortunatly, circumstances did not permit of carrying the detailed section further west than Mount Warren Hastings. Consequently the full thickness of these glacial beds is unknown. The knowledge of the beds obtained in 1924 suggests that the thickness recorded herein is likely to comprise almost the entire formation.

An account of the lower 800 feet, of which we have detailed information, is as follows, commencing at the base.

First a quartzite band about 10 feet thick immediately overlies the beds of section (13). There is no obvious unconformity. Then follows 85 feet of conglomerate with boulders of limestone and quartzite in roughly equal abundance. The boulders were noted up to 12 inches in diameter and are set in a quartzose arenaceous base. So far as noted, the limestone pebbles do not include examples with the Mawsonella markings.

Another band of quartzite about 43 feet thick follows, in turn passing upwards into a bed of conglomerate about 145 feet thick. In this the boulders, which were again observed up to 12 inches in diameter, are principally of quartzite, the limestones being of small size and less abundant.

Then comes another quartzite band about 15 feet thick, followed immediately by conglomerate about 175 feet thick, in which the pebbles attain much the same size as in the lower beds, but in which limestones are very rare.

The preceding fluvio-glacial beds then pass upwards into a definite tillite about 175 feet thick. The general colour of the rock is light grey and it has a rather slaty base. The boulders observed were mostly quartzite, but exhibited a greater diversity than that of the lower beds, including some examples that were taken to be partly decomposed basic lavas. Two striated quartzite boulders were recovered.

A strong belt of quartzite about 25 feet thick next succeeds, and is crowned by at least 140 feet of tillite, which brings the section to the alignment of Mount Warren Hastings. It is not, however, certain that the summit reached in this section is actually that named Mount Warren Hastings by the Survey Department. If not, it is one of the adjacent high points in the same belt. The country falls away further to the north-west, indicating either a waning of the resistant glacial conglomerates in the overlying strata or a cut-out by faulting. This last band of tillite at the summit has a base somewhat softer and more yellow in colour than the underlying tillites. The most remarkable feature is the great size of the boulders, some of which measured 6 feet across. The erratics are mainly quartzites, but one of the largest and most notable recorded was seen to be itself constituted of tillite. This may have been derived from lower horizons in the same series or from a still older tillite horizon of which we have evidence, to be published in due course.

General Remarks.

Evidence of a Time Break below the Lower Glacial Horizon.

The disturbed conditions arising from the initiation of volcanic activity and the inauguration of an ice age at this stage render it impossible, without a more exhaustive examination than has yet been made, to gauge to what extent, if any, a time break is represented at the base of the lower glacial horizon. There is, however, a lot of general evidence which seems to warrant such a conclusion, though the interval may not be great.

First of all, in travelling over the underlying beds between Wooltana homestead and Hart's Creek, some 10 miles to the north, they are seen to be more steeply tilted, more broken, more irregular and more indurated than the Munyallina beds. Next, basic igneous lavas and dykes with associated copper deposits are abundantly associated with them, but in the Munyallina beds nothing of the kind has yet been recorded. Again boulders of the underlying sediments and volcanic rocks are richly distributed through the glacial and fluvio-glacial strata of the Munyallina beds. Even boulders of a quartzite which appears to be identical with the basal quartzite of the underlying series are commonly met with in the Munyallina tillites.

In the year 1910, when in the rough country adjoining the Bolla Bollana Creek, I came across amygdaloidal basic lavas included in a sedimentary series capped unconformably by a tillite, which can scarcely be other than one of the Munyallina tillites.

Climatic Record.

This feature is quite remarkable, for great extremes are indicated. Dr. Woolnough has quoted evidences of aridity in the red colour and presence of suncracks in some of the beds; also in certain other lithological features of the sediments. The rich development of dolomites, and also the queer crystal moulds in some of the slate beds above the cave dolomite, point to the same conclusion.

Glacial conditions were not confined to one period, but recurred after what must have been a very long interval. This record of recurrence of glacial conditions in South Australian Proterozoic strata is not unique, for as long ago as 1906 I found in the north-east of the State evidences of recurrences of glacial conditions. Dr. R. L. Jack has recorded (8) a similar feature at Mount Grainger.

The Fossil Record.

The forms so far distinguished are all referable to calcareous algae. A curious feature of the upper limestones has been so referred by Mr. F. Chapman under the title of Mawsonella. What has thus far been recorded as Cryptozoön

in Central Australian and South Australian records, but which should perhaps be more correctly referred to Walcott's Collenia, is now recorded in the lower limestones of these beds. Oolitic structure is a feature of almost all the lower dolomitic limestones of the series; in the upper limit of this group of limestones it assumes a remarkable development in which the characteristic structure of Girvanella is wonderfully preserved. Other curious markings in the limestones may eventually be found to be referable to an organic origin.

Chronological Considerations.

I have located in the Mount Painter region two sedimentary series still older than the Munyallina beds and, in addition, a vastly more ancient crystalline terrain. Likewise I have established the existence, near Italowie Gorge, of unconformably overlying sediments in which archaeocyathus figures. No vestige of archaeocyathus has been found in the Munyallina beds. The inference, therefore, is that the beds are pre-Cambrian and, apparently, of late-Proterozoic age. The tillite horizons correlate them with the upper Adelaide Series. The oolitic character of the lower limestones and the overlying red beds suggest correlation of those limestones with the Brighton horizon of the Adelaide Series. But the cave dolomite and succeeding strata of the Munyallina beds appear to relate to a time of deposition post-dating the Brighton limestones and thus to have no counterpart in the Adelaide Series.

The oolitic and Collenia-bearing dolomitic limestones with associated red beds are probably referable to corresponding features of the Pertatataka Series of the McDonnell Ranges.

Recently, near Eurelia, some 163 miles south of Wooltana, I have met this same fossil assemblage strikingly developed. Girvanella in association with Collenia in limestones occupying a corresponding relation to a Proterozoic tillite horizon as that herein described. This limestone of the Eurelia locality has already on other considerations been regarded as corresponding with the Brighton limestone of the type area.

Summary.

The Munyallina beds appear to represent a continuous series estimated to total about 12,400 feet in thickness.

Interesting occurrences of what are regarded as calcareous algae—Girvanella, Collenia and Mawsonella—are met with in these sediments.

The climatic record is remarkable, ranging from severe glacial to probably warm arid conditions, and again glacial within the period of deposition of these beds.

A late-Proterozoic age is assigned to them. Correlation of portion of the series with the upper members of the Adelaide Series, including the Sturtian Tillite, is indicated. It would appear that these beds present a much more extended story of sedimentation during late Adelaidean times than is presented in the records of the Mount Lofty Ranges.

There seems to be no equivalent in the Adelaide region of members of the series above the chocolate shales underlying the cave dolomite.

There seems to be sufficient reason for adopting a time break below the basal glacial series of the Munyallina beds.

The underlying sediments are older-Proterozoic beds and should be equivalent of some portion of the lower Adelaide Series.

Bibliography.

1. "The Geology of the Flinders Range, South Australia, in the Neighbourhood of Wooltana Station," by Dr. W. G. Woolnough: Proc. Roy. Soc. N.S.W., vol. lx., p. 283. (Read Dec. 1, 1926.)
2. "Pre-Cambrian Areas in the North-Eastern Portion of South Australia and the Barrier, N.S.W.," by D. Mawson: A.A.A.S. Repts., vol. xiii., 1912, p. 188.
3. "Igneous Rocks of the Mount Painter Belt," by D. Mawson: Proc. Roy. Soc. S. Aust., vol. xlvii. (1923), p. 376.
4. "The Wooltana Basic Igneous Belt," by D. Mawson: Proc. Roy. Soc. S. Aust., vol. l., p. 192. (Read Aug. 6, 1926.)
5. "Notes on the Stratigraphy of Central Australia," by Dr. C. Chewings: Trans. Roy. Soc. S. Aust., vol. xxxviii. (1914), p. 51.
6. "On a New Genus of Calcareous Algae from the Lower Cambrian (?) West of Wooltana, South Australia," by F. Chapman: Proc. Roy. Soc. S. Aust., vol. li., p. 123.
7. "Report on the Occurrence of Natural Ammonium Sulphate and Chloride, associated with Guano in a cave deposit near Wooltana Head Station," by L. J. Winton, Chief Inspector of Mines: Mining Review No. 40, Dept. of Mines, S. Aust., 1924.
8. "The Mount Grainger Goldfield," by R. L. Jack, Assistant Government Geologist: Dept. of Mines, S. Aust., Report No. 2 (1913).

CLIMATE IN RELATION TO INSECT ECOLOGY IN AUSTRALIA. 1. MEAN MONTHLY PRECIPITATION AND ATMOSPHERIC SATURATION DEFICIT IN AUSTRALIA.

BY J. DAVIDSON, D.SC.

Summary

During the past few years considerable attention has been focussed on the relation of particular elements of climate and weather to the ecology of insects. There has been also a marked increase in experimental work dealing with the physiological responses of insects to the physical factors of their environment.

Certain meteorological data are used by workers investigating the geographical distribution and fluctuations in numbers of particular insects, with a view to correlating changes in the physical environment and biological responses of the species.

CLIMATE IN RELATION TO INSECT ECOLOGY IN AUSTRALIA.

1. MEAN MONTHLY PRECIPITATION AND ATMOSPHERIC SATURATION DEFICIT IN AUSTRALIA.

By J. Davidson, D.Sc.,
Waite Agricultural Research Institute, University of Adelaide.

[Read October 11, 1934.]

During the past few years considerable attention has been focussed on the relation of particular elements of climate and weather to the ecology of insects. There has been also a marked increase in experimental work dealing with the physiological responses of insects to the physical factors of their environment.

Certain meteorological data are used by workers investigating the geographical distribution and fluctuations in numbers of particular insects, with a view to correlating changes in the physical environment and biological responses of the species.

The methods for recording the usual meteorological data relating to weather were primarily designed with the object of accumulating precise knowledge bearing on the science of meteorology. Such data may not afford a true record of the sequence of changes occurring in the environment of particular species of insects. The micro-climate in a local situation, however, will be influenced by weather changes in the area; there will be a lag period which will vary with the degree of change and the character of the local situation.

A further consideration with respect to the use of meteorological data in ecological studies is the value which may be assigned to the mean of a series of records; with temperature and moisture (humidity) for instance, the nature of the fluctuations about the mean are particularly important. It is necessary to analyse the data with respect to specific investigations.

The monthly distribution in Australia of the important elements of climate governing the moisture available for animals and plants are shown in the twelve charts presented with this paper. The charts have been constructed from the latest data available.[1] Additional data have been obtained, as required, through the kindness of Mr. W. S. Watt, Commonwealth Meteorologist, and Mr. E. Bromley, Government Meteorologist of South Australia. I am grateful to these officers for their generous assistance in these matters.

Rainfall.

The charts show the average distribution of rain over Australia month by month. The areas have been defined so as to include increasing values of 1″ of rain; with areas of heavy rainfall, however, it was necessary to adopt a wider grouping of values in order to avoid the introduction of too many shaded areas. There are no recording stations over a large portion of the west central region of Australia; the hatching lines have been broken over this region.

The charts demonstrate three of the main features of rainfall in Australia:—(1) the seasonal incidence of summer rain in the northern and north-eastern portions of the Continent; and the seasonal incidence of winter rain over the southern portion of the Continent; (2) the concentration of rainfall in the coastal regions together with a progressive decrease in the amount of precipitation with increased distance from the coast; (3) the concentration of relatively heavy rain-

(1) Meteorological data for certain Australian localities. Pamphlet No. 42, C.S.I.R. (1933).

fall along the Queensland coast and the low rainfall area over the centre of the Continent, extending to the west coast, under the influence of the trade winds.

Various aspects of rainfall in Australia have been studied by a number of workers, notably by H. A. Hunt and Griffith Taylor. More recently, the seasonal incidence, concentration and reliability of rainfall have been discussed by J. Andrews (Proc. Linn. Soc. N.S.W., 1932 and 1933).

From the point of view of the ecology of insects, rainfall primarily determines the degree of moisture available at the soil surface and in the soil; it also influences the humidity of the air. Apart from these considerations, it affects the character of the vegetation and soil type in an area, which in themselves are major ecological factors.

Atmospheric Saturation Deficit.

The amount of water vapour in the air is generally recorded in terms of relative humidity, expressed as a percentage of the saturation value of air at the given temperature. Where the air temperature is known, the percentage relative humidity can be readily converted into a water vapour pressure value. The difference between the actual recorded vapour pressure of air and the vapour pressure value of saturated air at the same temperature is termed the "saturation deficit."

The latter is a function of the temperature and relative humidity of the air and can be calculated for stations where both data are available. From an ecological point of view it is preferable to consider atmospheric humidity in terms of saturation deficiency. The latter is the major factor influencing loss of moisture by evaporation. It has an important influence on the effectiveness of precipitation in relation to moisture in the environment of insects, particularly that of the soil and the soil surface.

The isopleths given on the charts show the distribution of mean values for the saturation deficit of the air month by month. Values for each station were calculated from the mean daily temperature for the month $\left(\frac{\text{max.} + \text{min.}}{2}\right)$ and the mean relative humidity.

The Australian meteorological service has selected the 9 a.m. reading for relative humidity as representative of the mean for the day. Prescott (1934, p. 55) has shown, from examination of records at the Waite Institute, that the mean of the 9 a.m. readings gives a satisfactory value for the purpose of calculating saturation deficit.

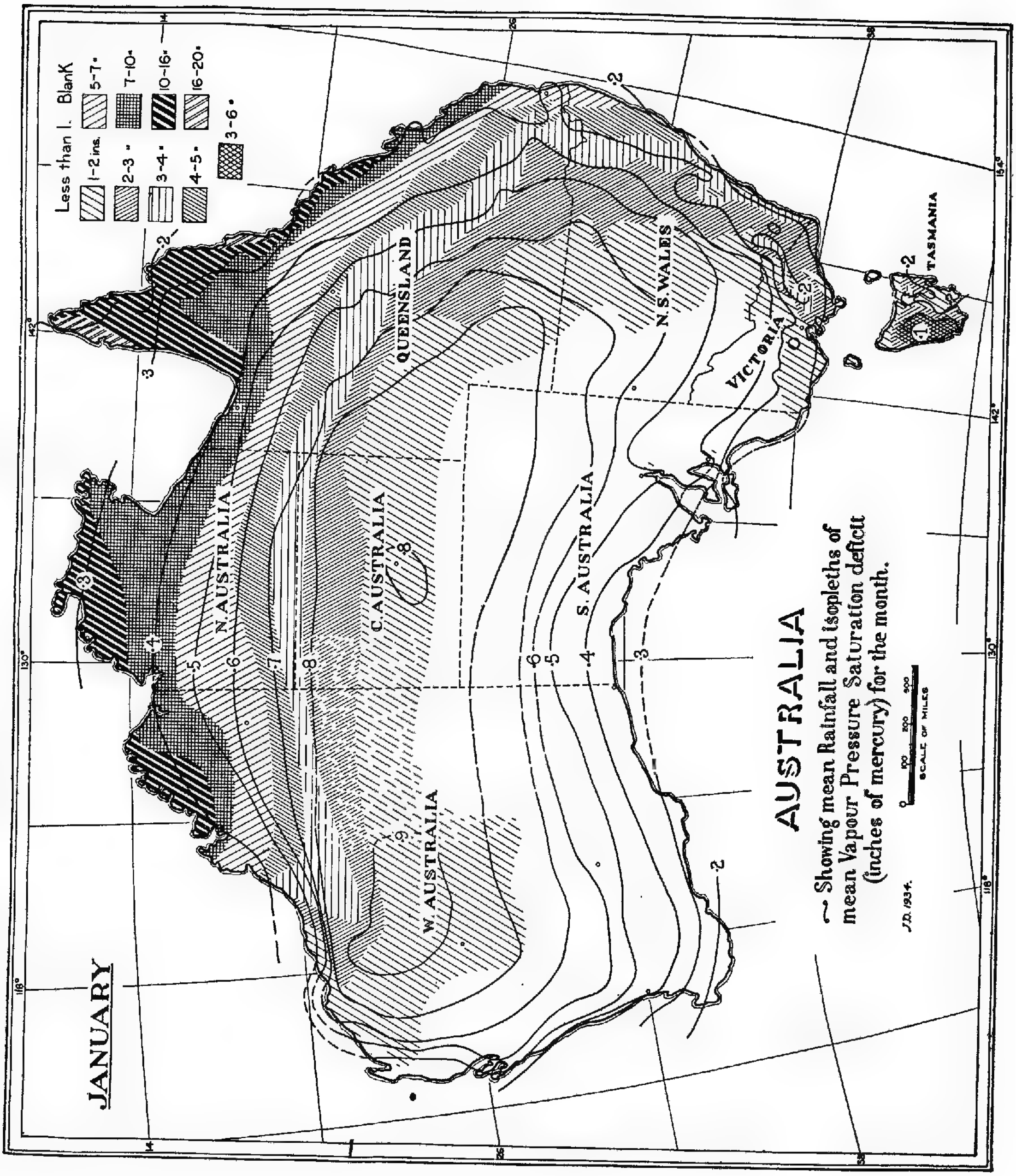
By reference to the values for saturation deficit and rainfall represented on the charts, a general picture may be obtained of the degree of dryness and wetness in any area of the Continent, month by month. Where values for saturation deficit can be expressed in terms of evaporation from a free water surface, the conditions may be more clearly defined. By this means the ratio of average rainfall to evaporation is obtained for the month; this ratio affords a useful index to the degree of dryness or wetness in the area. This subject has been dealt with in earlier papers (Davidson, 1933, 1934); it will be discussed further in the second part of the present paper.

References.

Davidson, J. 1933—The distribution of Sminthurus viridis L. (Collembola) in South Australia based on rainfall, evaporation and temperature. Australian Journ. Exp. Biol. and Med. Sc. 11 : 59-66.

Davidson, J. 1934—The monthly precipitation-evaporation ratio in Australia as determined by saturation deficit. Trans. Roy. Soc. S. Aust., 58, pp. 33-36.

Prescott, J. A. 1934—Single climatic factors. Trans. Roy. Soc. S. Aust., 58, pp. 48-61.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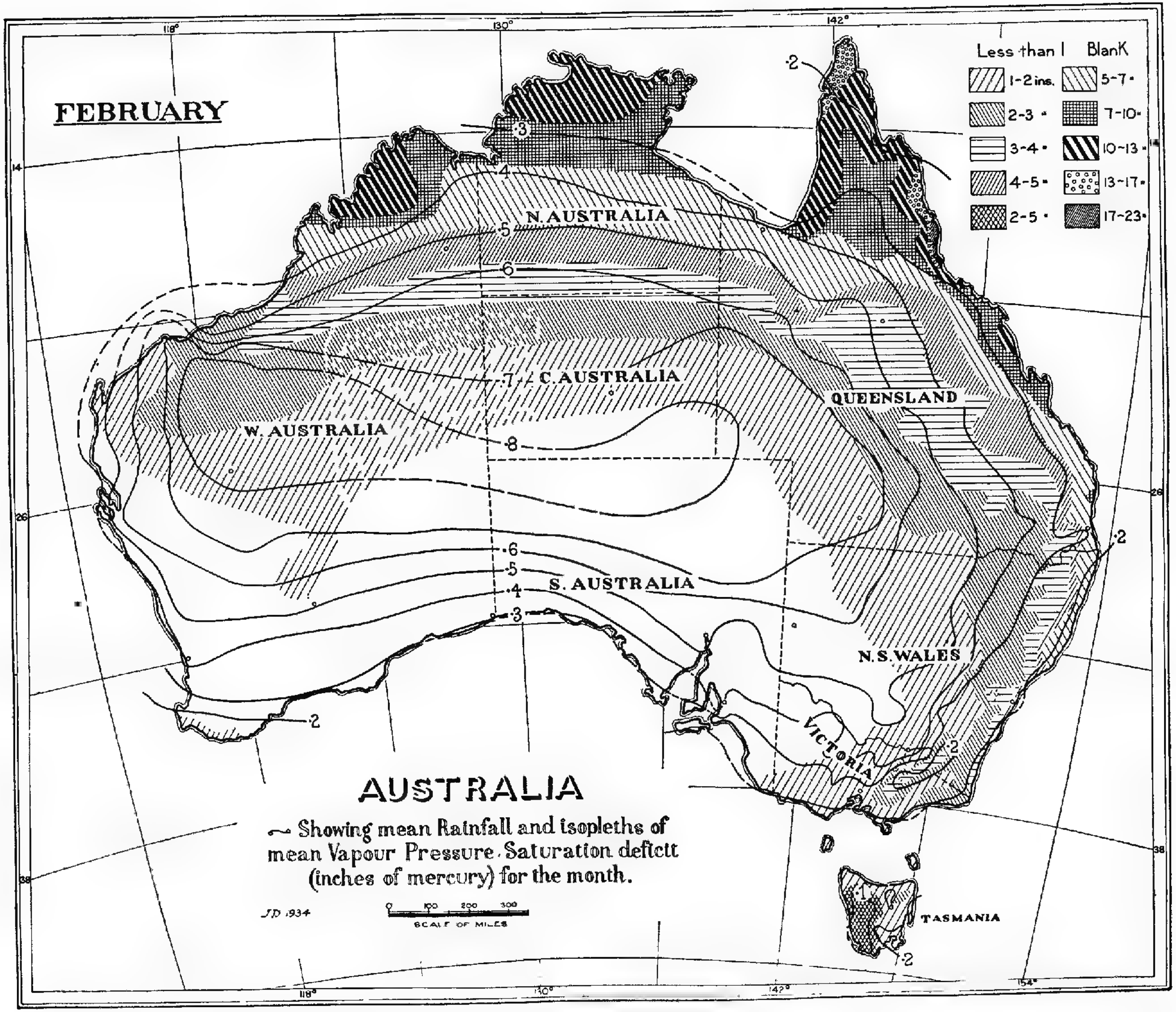

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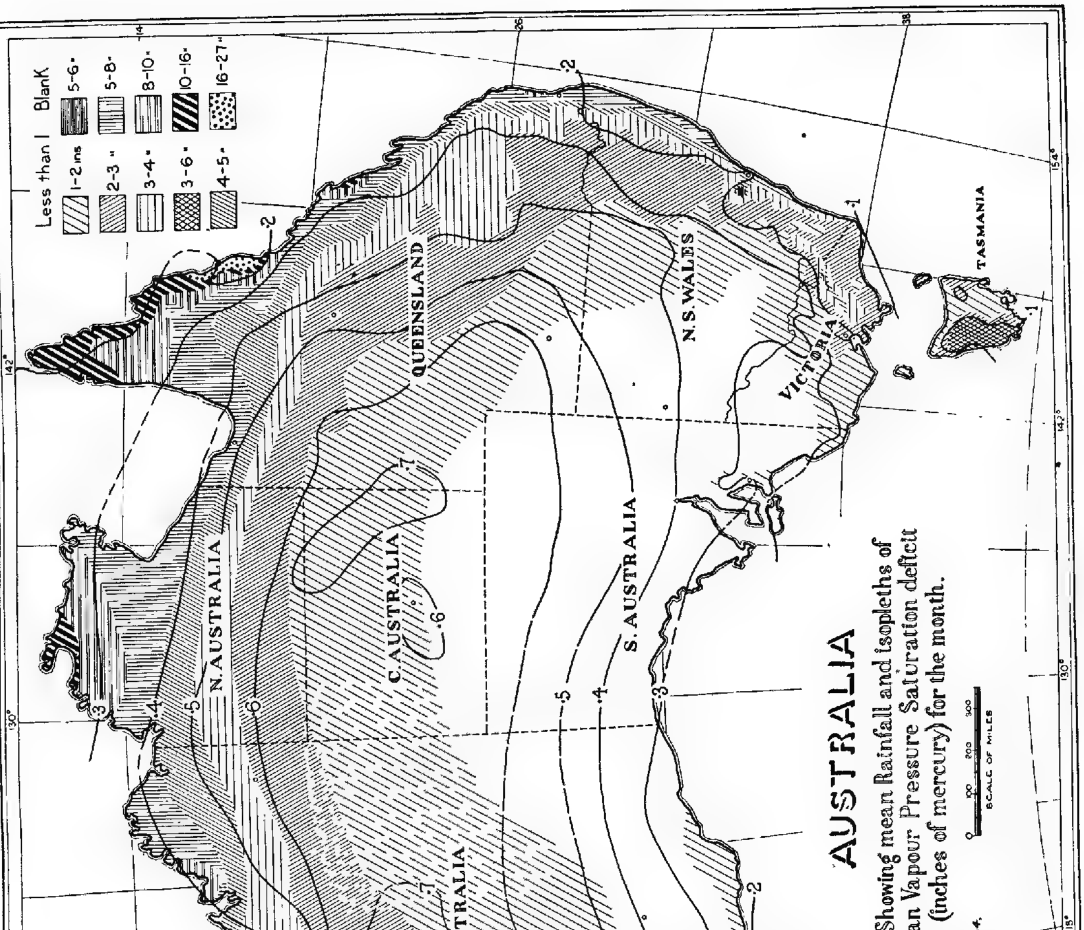
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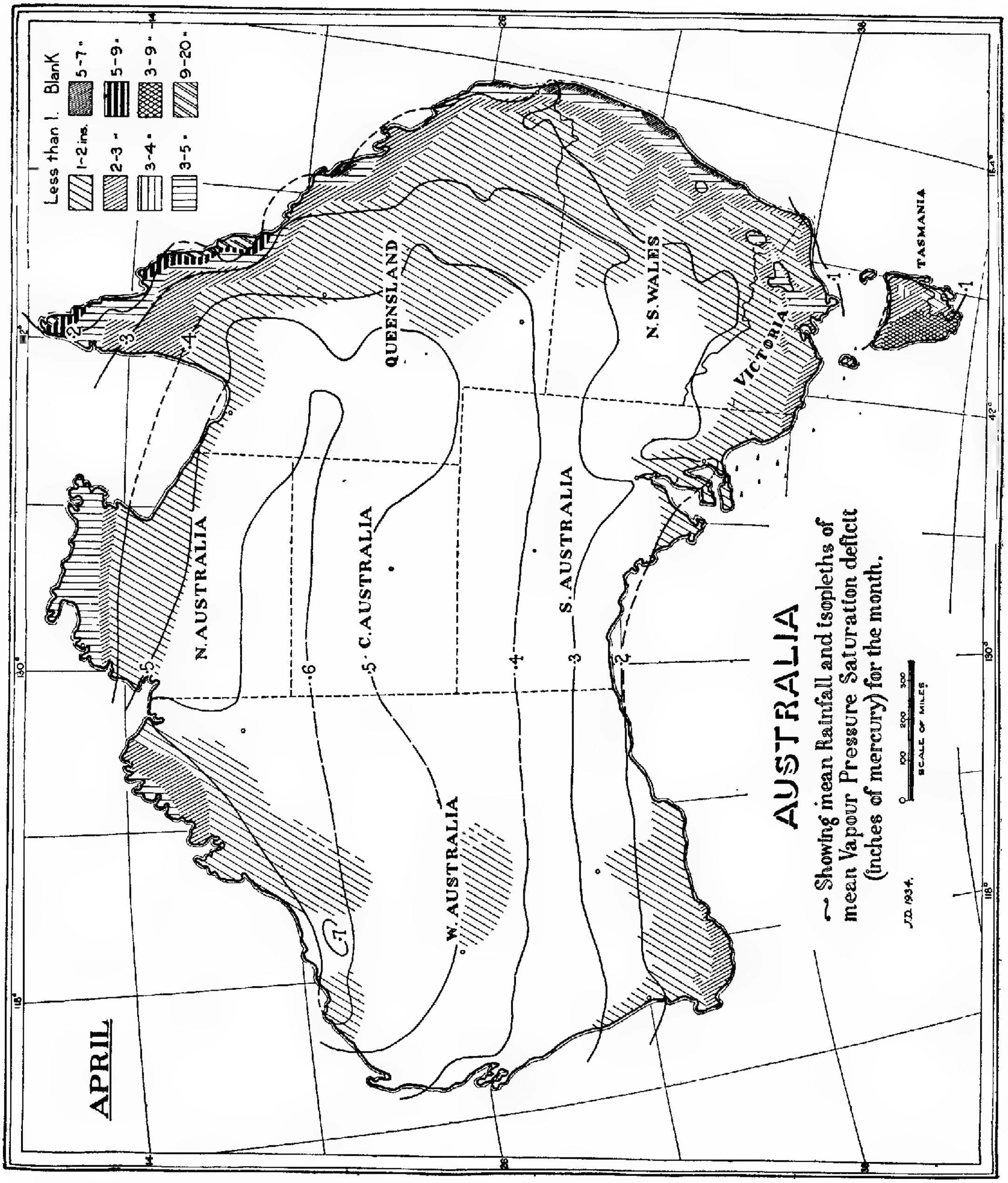
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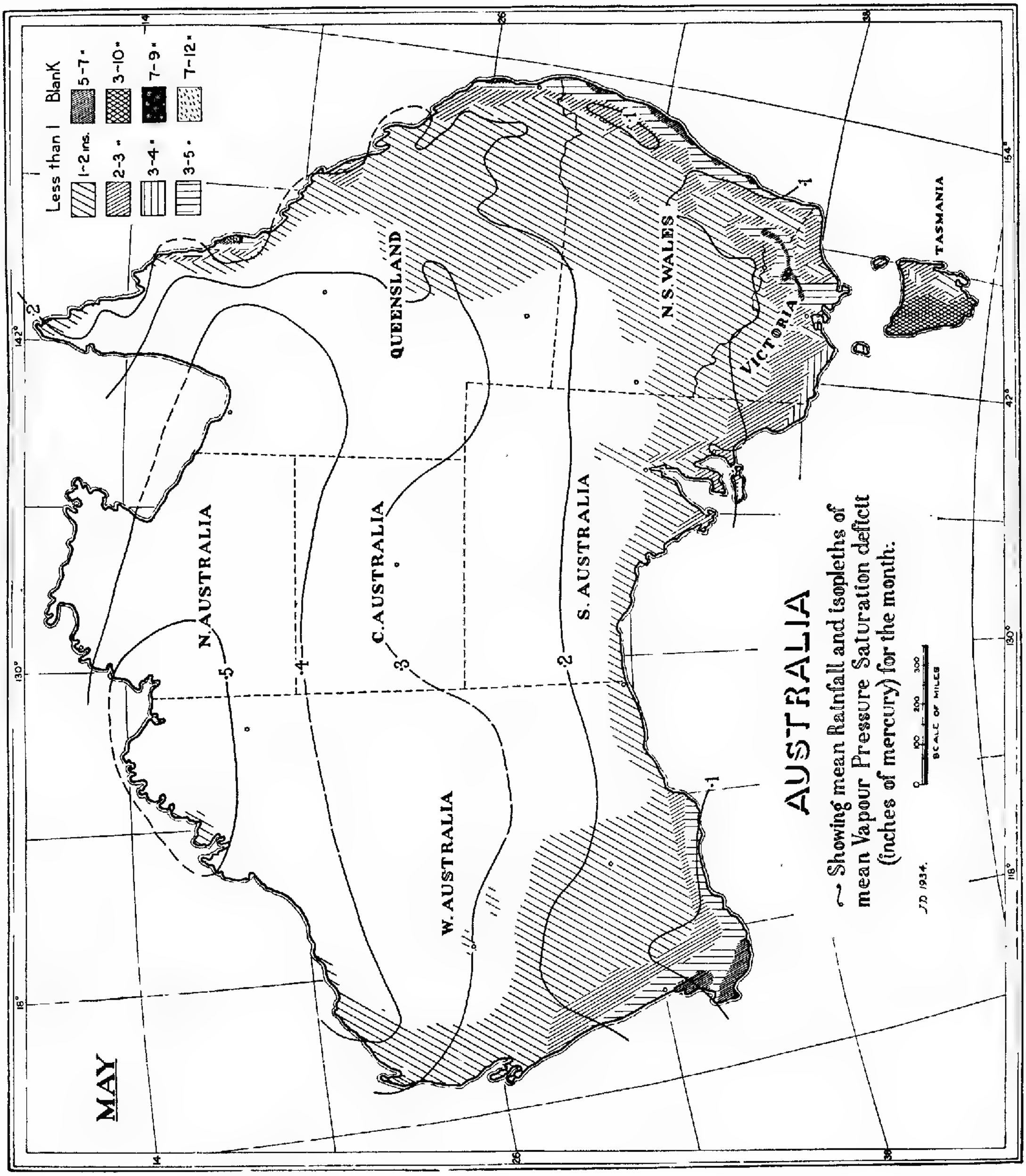
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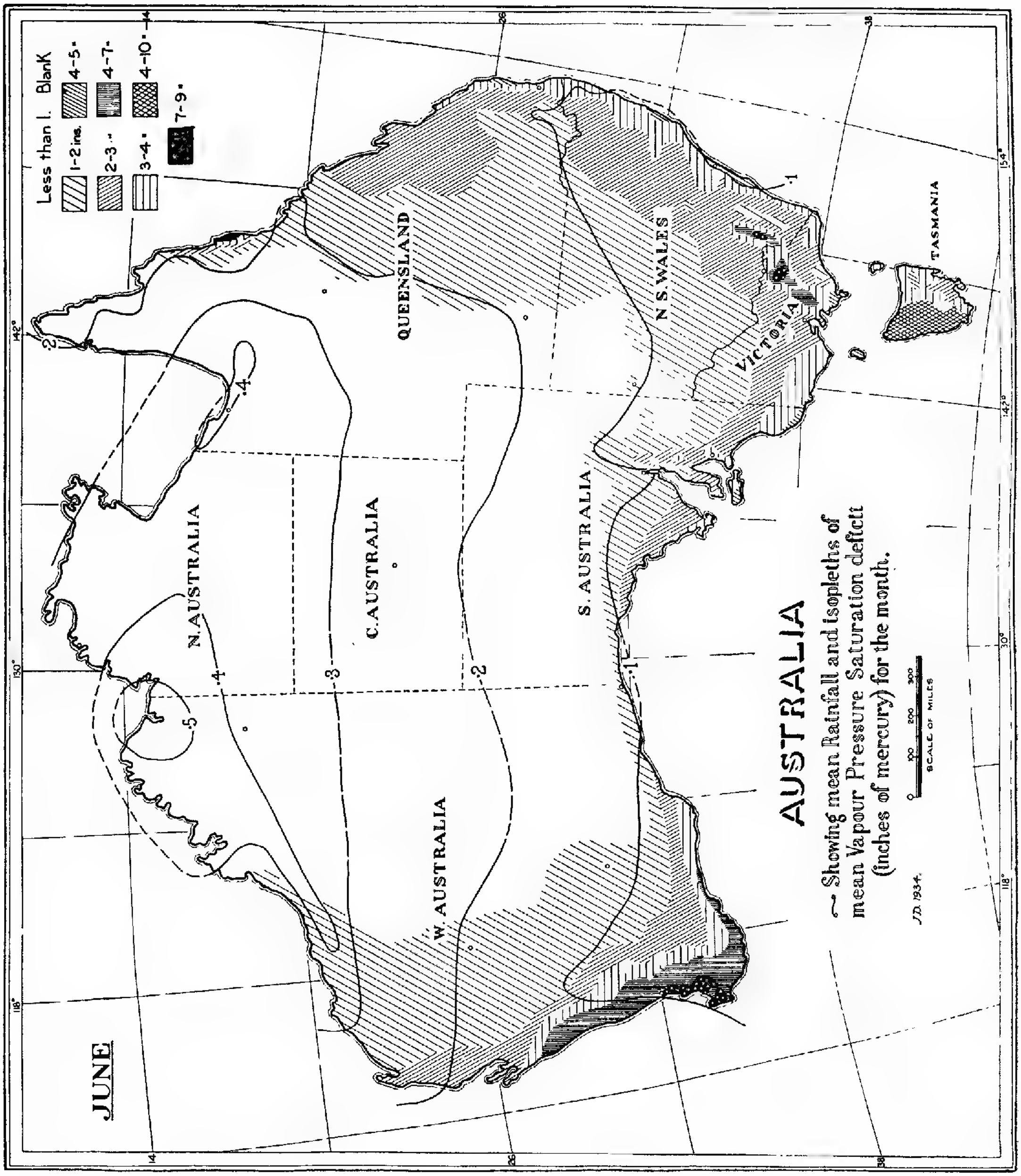
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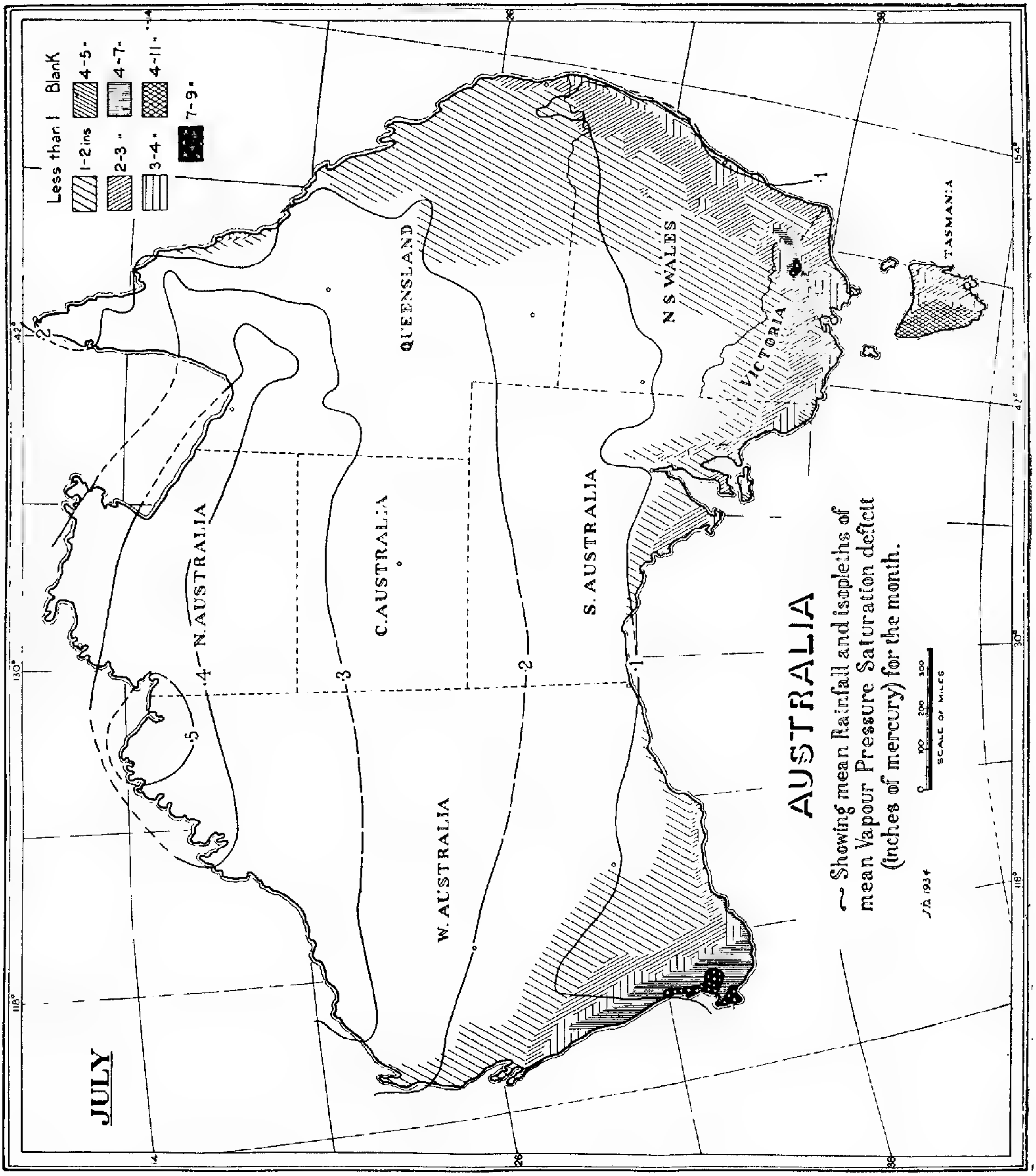
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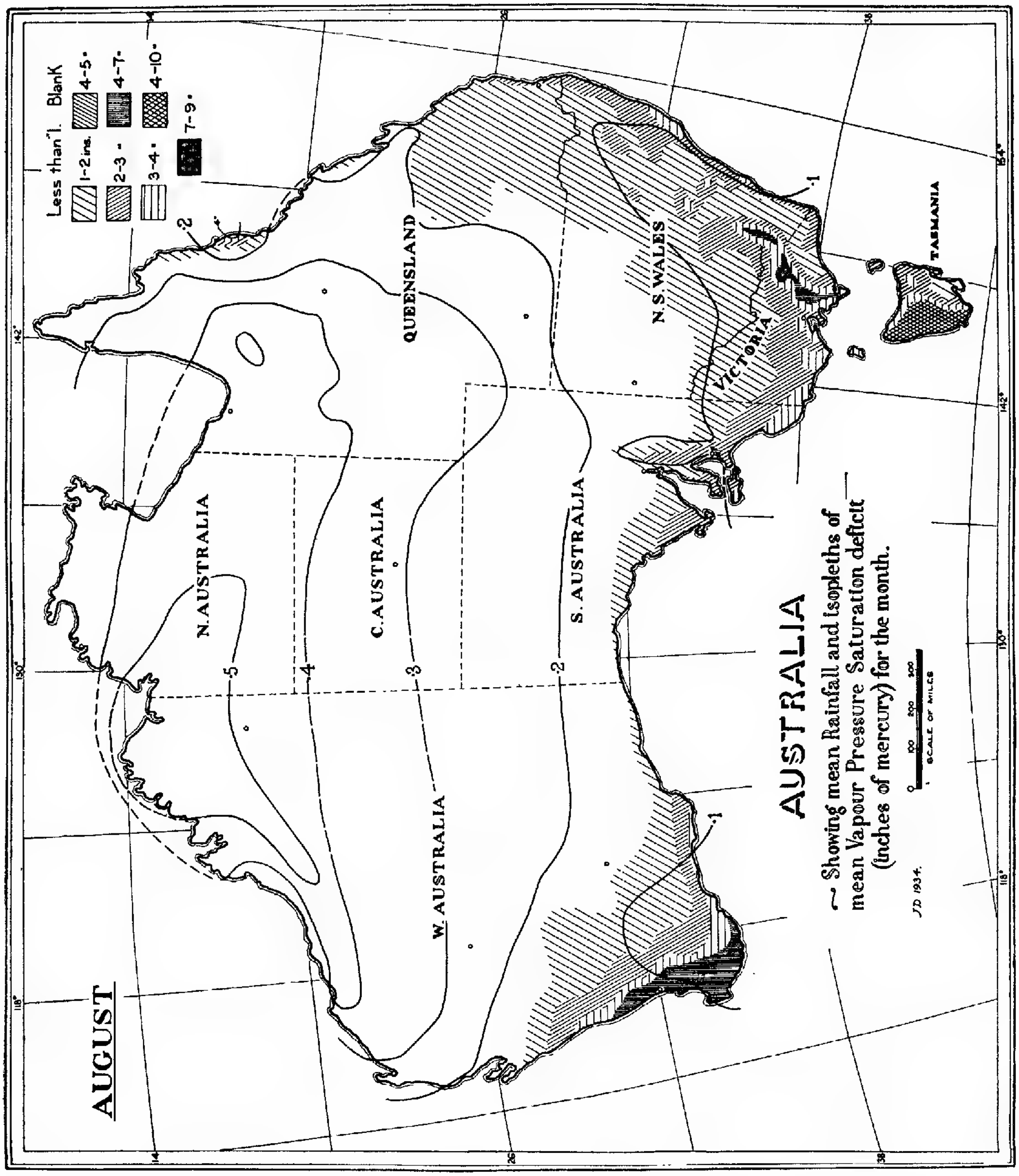
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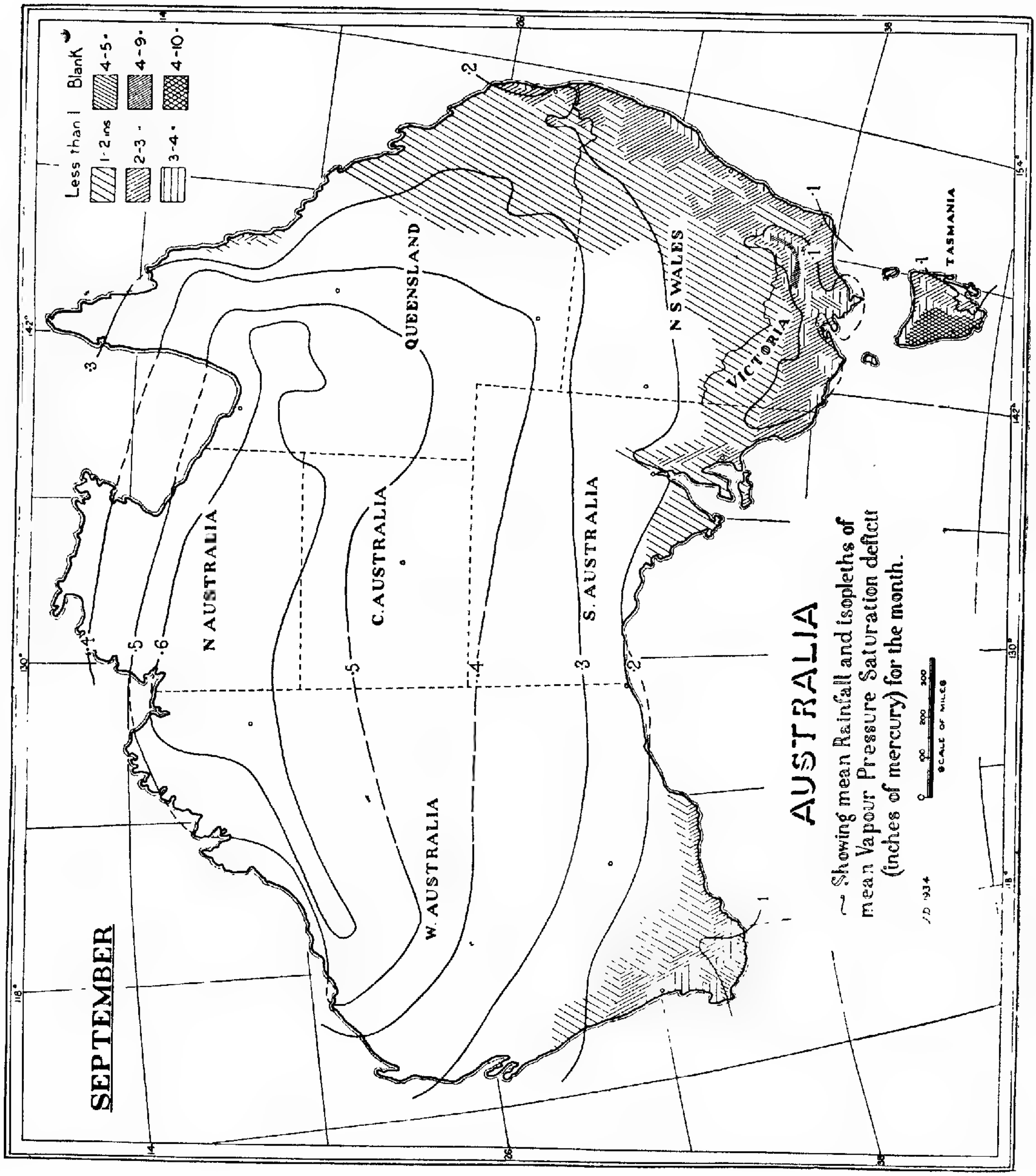
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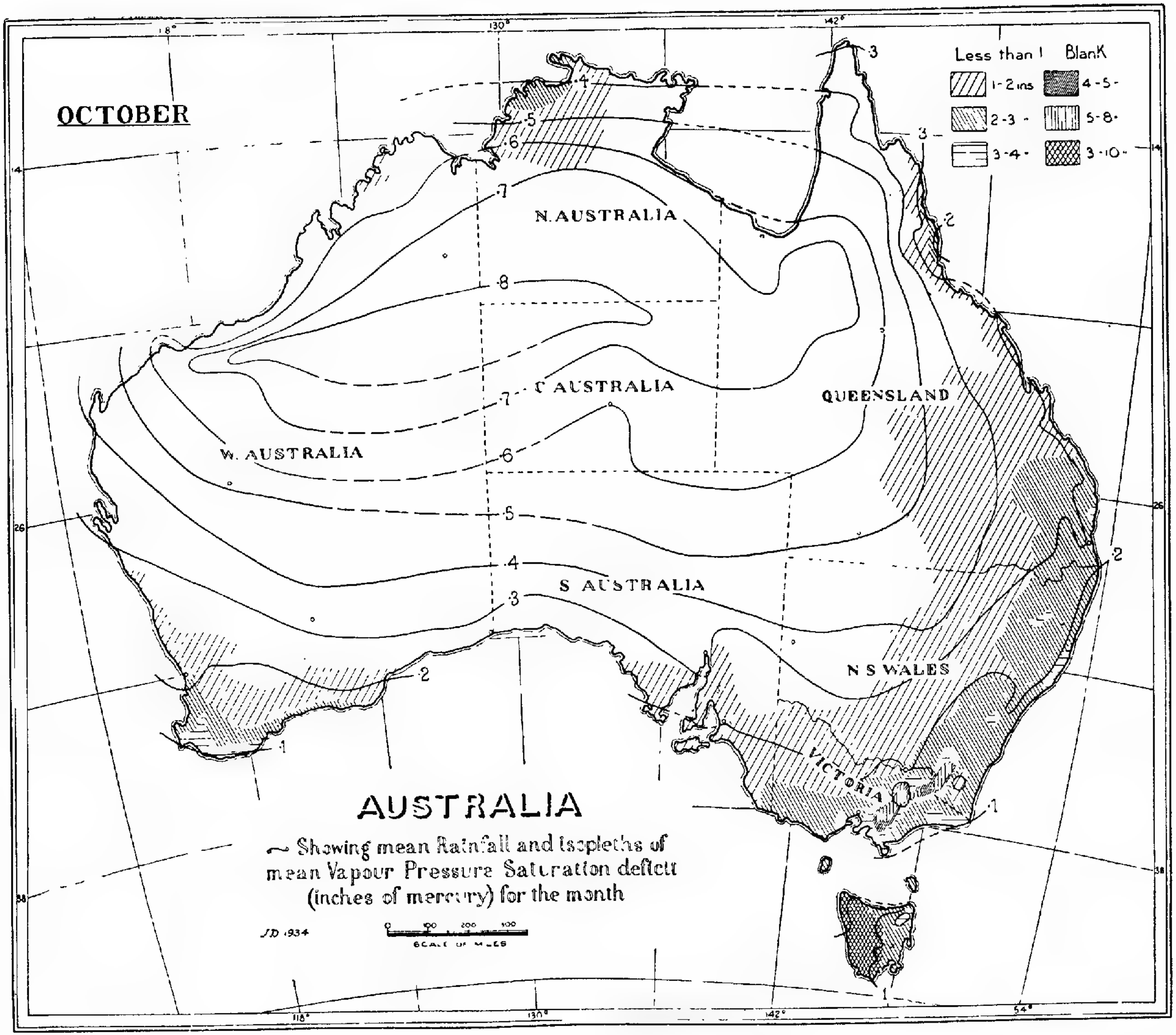
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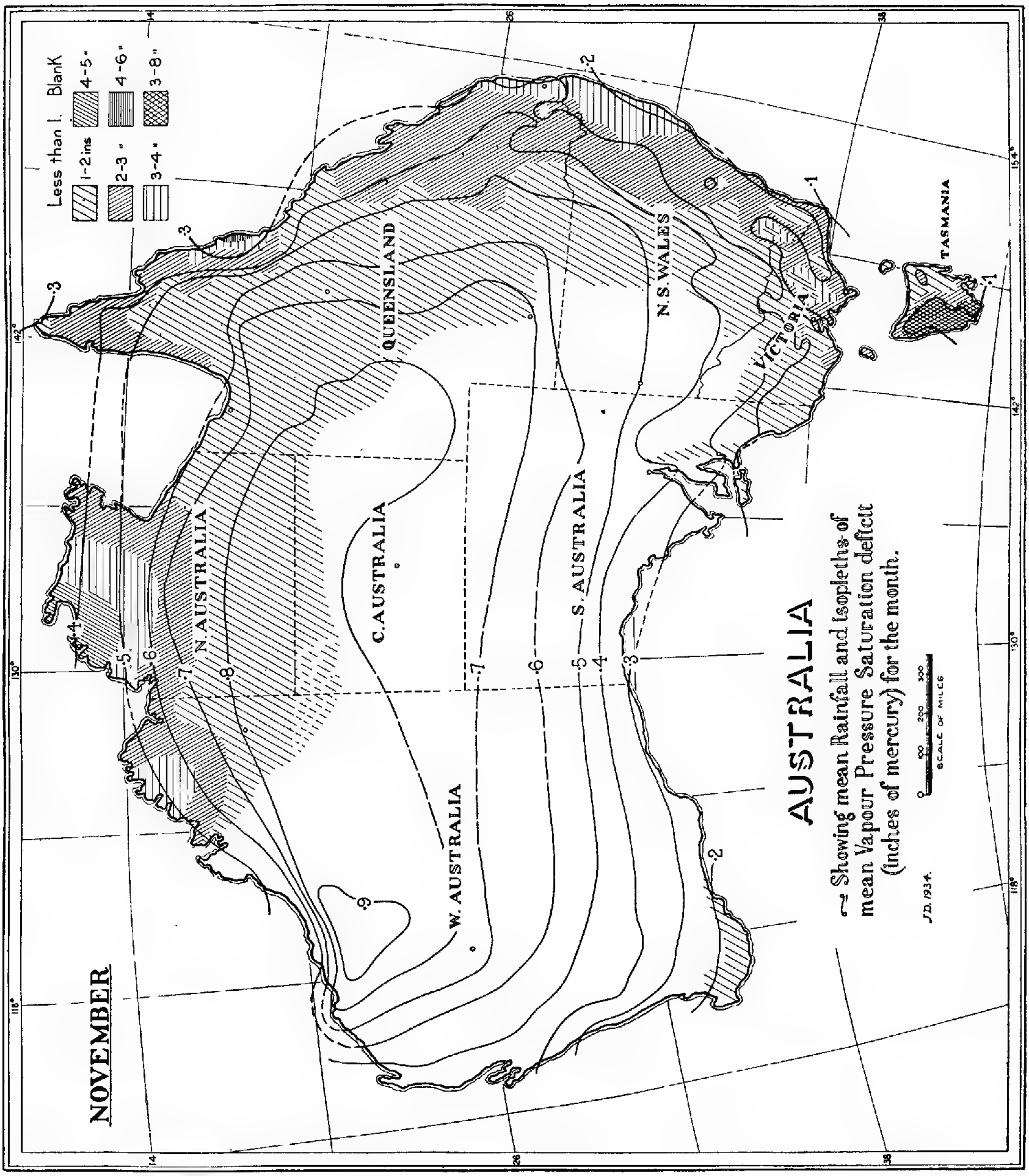
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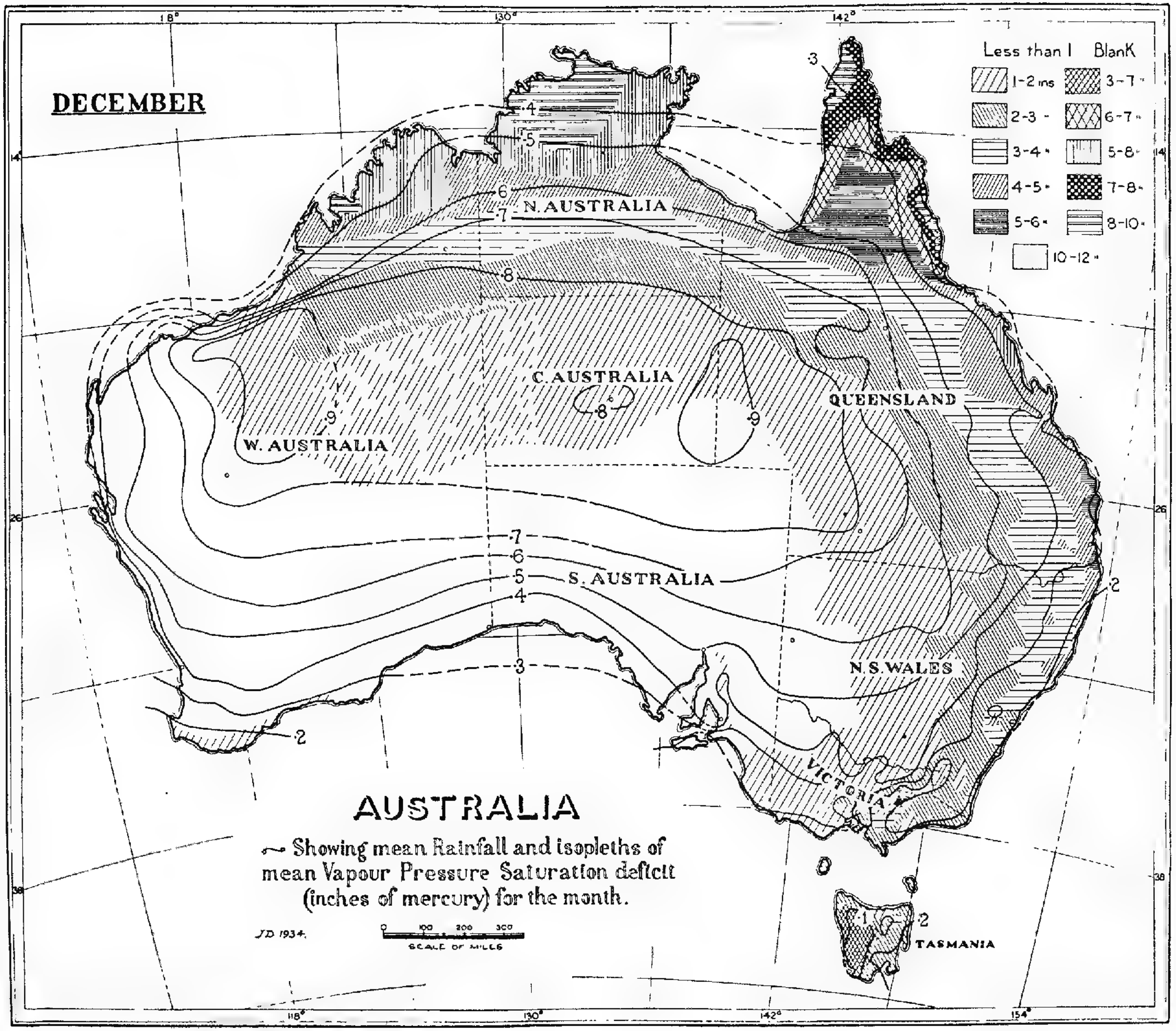

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AUSTRALIAN FUNGI: NOTES AND DESCRIPTIONS.- NO. 10.

BY J. BURTON CLELAND, M.D.

Summary

The present contribution gives descriptions in Latin of various Australian Fungi. Descriptions in English of Nos. 594 to 613 have already appeared in the author's "Toadstools and Mushrooms and other Larger Fungi of South Australia. Part I." Government Printer Adelaide, 1934. To make these species valid, according to the Rules of Botanical Nomenclature, Latin descriptions must be supplied. Descriptions in English of the new species of *Boletus* (Nos. 614 to 619) here described have been prepared for Part 11. of the above work.

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By J. Burton Cleland, M.D.

[Read October 11, 1934.]

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594. *Tricholoma sublilacinum* Clel.—Planta sublilacina. Pileus ad 4·3 cm., irregulariter planus vel repandus, subumbonatus, glaber, hygrophanus, primo margine introversa, benzo-brunneus, ubi exsiccatus pallido-cinereus ad albidum. Lamellae adnatae, usitate dentibus decurrentibus, subconfertae, pallido-brunneo-cinereae. Stipes ad 3·1 cm., tenuis, saepe curvatus, substriatus, pallido-cinereus. Sporae ellipticae, obliquae, 6-7 × 3·5 μ. S.A.—Mylor.

595. *Collybia pinicolens* Clel.—Pileus 1·8-2·5 cm., planus vel subconvexus, umbilicatus, a margine striato-rugosus, pertenuis, sublentus, hygrophanus, "Rood's brown," ubi exsiccatus pallido-carneo-cinnamoneus. Lamellae adnatae, subconfertae, angustae, concoloratae. Stipes 6·2 cm., tenuis, aequalis, lentus, cartilagineus, pervillosus, concolaratus, ad basem inter pini folia fibrillis diffusis et filis myceliosis. Sporae obliquae, 8·5 × 4 μ. S.A.—Mount Burr.

596. *Entoloma Bloxami* Berk. var. *angulata* Clel. -Sporae angulatae, 8 × 5 μ. S.A.—Mount Burr.

597. *Hebeloma lamelliconfertum* Clel.—Pileus ad 8·7 cm., convexus, deinde subplanus vel subconcavus, interdum subrepandus, subfibrillosus, flavo-brunneus. Lamellae adnatae, deinde subsinuatae, confertae, pallido-flavo-brunneae, deinde flavo-brunneae. Stipes 6·2 cm., crassus, subfibrillosus, albidus. Sporae subangustae, pallido-brunneae, 9 × 4·5 μ. S.A.—Ashbourne.

598. *Flammula paludosa* Clel.—Pileus 1·8-3·1 cm., convexus, deinde subplanus vel irregulariter depressus vel concavus, subtomentosus, circum marginem flavo-brunneus, in centro brunneus. Lamellae adnatae vel subsinuatae, subconfertae, ventricosae, flavo-brunneae vel subfulvae. Stipes brevis, 1·2-1·8 cm., subtenuis vel subcrassus, aequalis vel infra attenuatus, farinaceus vel fibrillosus, solidus vel subcavus, flavo-brunneus, infra subniger. Sporae obliquiter piriformes, subasprae, flavo-brunneae, 9·5-11 × 6-7·5 μ. Prope paludem. S.A.—Mount Compass.

599. *F. excentrica* Clel. et Cheel. var. *macrospora* Clel.—Sporae 9·5-15 × 5·5-7·5 μ. S.A.—Upper Tunkalilla Creek, Kinchina, Mount Burr.

600. *F. eucalyptorum* Clel.—Pileus 1·2-3 cm., perconvexus, deinde expansus, villoso-fibrillosus vel substrigosus, rhamnoso-brunneus, fulvus vel succineo-brunneus. Lamellae sinuato-adnexae, subconfertae, angustae, subventricosae, inter ochraceum et ochraceo-lutem, ochraceo-fulvae, vel inter succineo-brunneum et "Sudan-brown." Stipes 1·2-3·7 cm., saepe curvatus, infra subfibrillosus, supra farinosus, solidus vel subcavus, supra pallidus, infra flavo-brunneus vel ochraceo-luteus. Sporae obliquiter ellipticae, saepe subasprae, flavo-brunneae,

7-9 × 4·5-6 μ. Plantae de Eucalyptorum truncis cariosis. S.A.—Kuitpo, Mount Lofty Ranges.

601. *F. arenario-bulbosa* Clel.—Pileus ad 3·7 cm. et magis, convexus, villoso-fibrillosus, subsquamosus vel subrimosus, ochraceo-luteus ad fulvum. Lamellae sinuatae, subconfertae, ventricosae, isabellinae. Stipes brevis, 2·5 cm., fibrillosus, subcavus, ad basem bulbo arenario-incrustato, ochraceo-luteus. Velum subflavum, stipem vestiens. Caro flava. Sporae ellipticae, flavo-brunneae, 8·5 × 5·6 μ. S.A.—Encounter Bay.

602. *Naucoria subfulva* Clel.—Pileus 16 mm., convexus, interdum subumbilicatus, tomentosus, ochraceo-fulvus ad fulvo-olivaceum. Lamellae adnatae ad sinuato-adnatas, subventricosae, subconfertae, subcrispatae, tabacino-brunneae vel fulvo-olivaceae. Stipes brevis, 1·2 cm., tenuis fibrillosus, subcavus, subfulvo-pallidus. Sporae obliquae, pallido-brunneae, 8·5-11 × 4·5-5·5 μ. In terra. S.A.—Myponga.

603. *N. veronabrunnea* Clel.—Pileus 1.2-1·6 cm., perconvexus, subumbonatus, fibrillosus, hygrophanus, verona-brunneus, exsiccatus pallidus. Lamellae sinuatae, subconfertae, ventricosae, verona-brunneae, marginibus pallidioribus et serratis. Stipes 5 cm., aequalis, flexuosus, supra farinosus, infra fibrillosus, solidus, brunneo-pallidus. Sporae subangustae, obliquae, brunneae, 8·2 × 4 μ. In terra. S.A.—Mount Lofty.

604. *Crepidotus prostratus* Clel.—Pileus approxime 3-6·2 × 3-5 cm., irregularis, subconvexus, in medio depressus, furfuraceo-squamosus vel subtomentosus, interdum margine substriato, hygrophanus, ochraceo-fulvus ad ochraceum vel brunneus, ubi exsiccatus fulvo-olivaceus. Lamellae subconfertae, perdecurrentes, interdum anastomosae, rhamnoso-tabacino- vel cinnamoneo-brunneae. Stipes subcentralis, excentricus vel sublateralis, brevis, 1·2-1·8 cm., subcrassus (7 mm.), solidus, albus vel pallidus. Sporae ellipticae, flavo-brunneae vel brunneae, 8-9·5 × 4·8-5·5 μ. Plantae caespitosae et imbricatae ad truncorum bases. S.A.—Monarto South, Kinchina, Coonalpyn, N.S.W.—Bumberry.

605. *Psilocybe asperospora* Clel.—Pileus 7·5 cm., conico-convexus, subgibbosus, brunneus, fibris fasciculatis. Lamellae adnatae, saepe subdecurrentes, subconfertae, subnigrae. Stipes ad 15 cm., subcrassus, filis subnigris fibrillosus, supra punctis subnigris pruinosus, subcavus, brunneo-pallidus. Velum superius. Sporae asperae, ovales, obliquae, subnigrae, 8·5-12 × 7 μ. S.A.—National Park.

606. *Ps. subuda* Clel.—Pileus 1-2·5 cm., campanulato-convexus vel hemisphericus, viscidus vel subviscidus, interdum substriatus, isabellinus vel ochraceo-fulvus, margine olivaceo-ochraceo. Lamellae adnatae, triangulares, subconfertae, flavo-virides deinde fusco-cinereae, marginibus albis. Stipes 6·8-7·5 cm., tenuis, aequalis, nitidus, interdum substriatus, subcavus, pallido-brunneus vel ochraceo-fulvus. Sporae ellipticae, purpureo-fuscae, 13-19 × 8·5-10 μ. In stercore. S.A.—Mount Compass, Myponga, National Park, Waterfall Gully.

607. *Ps. echinata* Clel.—Primum pileus globosus, echinatus; deinde 18 mm., hemisphericus ad convexum ad subplanum, subfibrillosus, fuscus, Lamellae adnexae, confertae, angustae, rubicunda-brunneae deinde fuscae. Stipes 2·5-3·1 cm., aequalis, fibrillosus deinde glaber, subcavus, pallidus deinde brunneo-pallidus, ad basem mycelio floccoso. Sporae ellipticae, obliquae, fuscae, 7-7·5 × 4 μ. Plantae gregariosae ad subcaespitosae, ad bases truncorum cariosorum. S.A.—Mount Lofty.

608. *Russula Cheelii* Clel.—Pileus 7·5 cm., convexus in medio depressus, viscidus, luteus, margine subrugosa. Lamellae adnatae, confertae, proxime stipiti saepe furcatae, angustae, cremaceae deinde submaculatae. Stipes 6·2 cm.,

subaequalis vel infra subattenuatus, substriatus, albus. Sapor mitis. Sporae piriformes, verrucosae, 8·5 × 6·5 μ. S.A.—Kuitpo.

609. *Coprinus sterquilinus* Fr. var. *radicatus* Clel.—Stipes radice fastigata, longa, 1·2-3·7 cm. Plantae inter gramina, non in stercore. S.A.—Kinchina, Encounter Bay, Beaumont.

610. *Marasmius cinnamoneus* Clel.—Pileus ad 1·2 cm., irregulariter convexus, deinde subplanus, subvillosus, subrugosus, interdum, circum marginem substriatus, pallido-carneo-cinnamoneus ad carneo-luteum, pallido-vinaceo-cinnamoneus vel pallido-ochraceo-salmonicolor. Lamellae adnatae, deinde secedentes, subconfertae ad subdistantes, subventricosae, deinde marginibus subserratis, cremaceo-albae. Stipes ad 1·2 cm., deinde 2·5 cm., tenuis, subvelutinus vel glaber, "Hessian brown" vel "Vandyke brown" vel pallidior, interdum infra subniger, matricem abrupte penetrans. Odor nullus. Sporae subsphericales ad piriformes, apiculo obliquo, hyaline, 7·5 × 6 μ, 7·5-9 × 4 μ. De cortice ad bases Eucalyptorum vivorum. S.A.—National Park, Mount Lofty, Willunga Hill, Inman Valley.

611. *M. villosipes* Clel.—Pileus 1·2-2·7 cm., irregulariter convexus, interdum irregulariter rugosus, margine lacerato, subnigro-brunneus, ubi exsiccatus colore graminis sicci. Lamellae adnatae, subconfertae ad subdistantes, avellaneae. Stipes 3·1-3·7 cm., tenuis, lentus, pervillosus, subnigro-luteo-brunneus. Sporae piriformes, 5·5 × 3·5 μ. In terra sub pinis vel inter gramina. S.A.—Mount Gambier, Kalangadoo.

612. *M. australiensis* Clel.—Pileus 15 mm., convexus, umbilicatus vel irregulariter planus, irregulariter subrugosus, subfibrillosus, "Sayal brown." Lamellae adnatae, subconfertae, glauco-brunneae. Stipes ad 18 mm., infra subattenuatus, pervillosus, cinereo-brunneus. Sporae 7·5 × 3·5 μ. In ligno. S.A.—National Park.

613. *Cantharellus ochraceus* Clel.—Pileus 2·5-3·7 cm., convexus, subirregularis, ochraceo-fulvus et cinnamoneus. Lamellae arcuate subdecurrentes, subdistantes, interdum in exteriores partes furcatae, pallido-ochraceo-luteae. Stipes 3-3·7 cm., subirregularis, infra attenuatus vel irregulariter crassus, subfibrillosus, ochraceo-luteus. Sporae piriformes, 6·5 × 4 μ. In terra. S.A.—National Park.

614. *Boletus fuscus*, n. sp.—Pileus 7·5 cm., convexus, viscidus, fuscus. Tubuli 1·2 cm., antiquo-aurei, ubi contusi livido-virides, ubi caesi cyaneo-virides; oribus sublargis et irregularibus. Stipes 6·2 cm., crassus (1·8 cm.), supra reticulatus, infra subpunctatus, solidus, fuligino-brunneus. Caro subbrunneo-albida. Sporae elongatae, pallido-brunneae, 9-10 × 3·75 μ. S.A.—Mount Lofty.

615. *B. punctato-brunneus*, n. sp.—Pileus 8·7-12·5 cm., irregulariter convexus ad subplanum, viscidus, deinde velutinus, Verona-brunneus ad sepia-brunneum. Tubuli 1·2-1·8 cm., circum stipitem sulcus, pallido-flavi, deinde sordido-flavi, deinde olivacei; oribus subparvis. Stipes 3-8·7 cm., tenuis ad crassum (1·8-4·6 cm.), aequalis vel infra attenuatus, punctato-brunneus. Caro subrubra vel sordido-brunnea, interdum apud tubulis cyaneo-viridis. Sporae elongatae, pallido-brunneae, 9-12 × 3-4 μ. S.A.—Waterfall Gully, Mount Lofty, Second Valley, Middleton, Kangaroo Island.

616. *B. sinape-cruentus*, n. sp.—Pileus 7·5-12·5 cm., convexus, raro in centro depressus, viscidus, sinape-croceus et cruentus et brunneus. Tubuli 5-25 mm., circum stipitem sulcus, intus attenuati, subventricosi, angulati, sinape-crocei vel lutei vel melleo-flavi; oribus 0·5-1 mm. Stipes 5-7·5 × 1·8 cm., infra et interdum supra attenuatus, luteus ad sinape-croceum, rubro-punctatus. Caro primulino-crocea, in locis cyaneo-viridis. Sporae elongatae, brunneae, 10·5-15 × 4-5 μ. S.A.—National Park, Mount Lofty, Eagle-on-the-Hill.

617. *B. multicolor,* n. sp.—Pileus 5-7·5 cm., convexus, subtomentosus, olivaceo-et rubicundo-brunneus, ruber et croceus. Tubuli 6-12 mm. circum stipem sulco, succineo-flavae vel croceae; oribus minutis. Stipes 2·5-11·2 cm., crassus (in medio 3·7 cm., supra 2·5 cm.), interdum ad basem attenuatus, subgranulosus vel subrugosus, croceus maculis rubicunda-brunneis. Caro crocea, deinde subrubra vel cyanea. Sporae elongatae, pallido-flavae, 9·5-11-13 ×2-4 μ. S.A.—Bangham, Encounter Bay, Mount Compass, Second Valley, Kinchina.

618. *B. fuscescens,* n. sp.—Pileus 6·2-13·7 cm., perconvexus, saepe in centro depressus, saepe subirregularis, mollis, velutino-fibrillosus, probabiliter subviscidus, tabacino-brunneus vel cinnamoneo-cinereus vel subfuscus. Tubuli 1·2-1·8 cm., circum stipitem sulcus exiguus, intus et extra attenuati, olivaceo-lutei ad "chamois," deinde subfusci; oribus rotundis, duobus vel minus in 1 cm. Stipes 5-6·2 c.m,, crassus (1·8-4·3 cm.), primo perbulbosus, satur-olivaceo-luteus deinde fuscus, punctatus. Caro pallida, deinde fusca et subnigra. Sporae elongatae, subbrunneae, 9-13 × 3·2-4 μ. S.A.—Encounter Bay, Kuitpo, Willunga Hill, Mount Lofty, MacDonnell Bay.

619. *B. mollis,* n. sp.—Pileus 8·7 cm., subplanus, viscidus, flavo-brunneus ad martis-brunneum. Tubuli 2·5 cm., circum stipitem sulcus, cinnamoneo-cinerei et cinereo-carnei; oribus 1 mm., irregularibus. Stipes 3·7 cm., subtenuis, supra expansus, subfibrillosus, infra badius, supra pallidior. Planta mollis. Sporae elongate, brunneae, 17-18·7 × 5 μ. S.A.—Penola.

NOTES ON THE FLORA OF SOUTH AUSTRALIA.-NO. 3.

BY ERNEST H. ISING

Summary

A review of certain species of *Casuarina* contained in an article (4) by E. D. Macklin gives information which will help in the diagnosis of this difficult genus. Amongst other details Macklin says:- "The following are the most important vegetative features: the angularity of the ridges, the size and nature of the sheathing teeth in each whorl and the length of the internodes. As regards the cones of the species dealt with in this paper, only the presence or absence of the dorsal protuberance of the valves and the degree of protrusion of the latter are worth consideration. The greatest assistance to taxonomic work . . . is to be gleaned from the male inflorescence. The average length of the male spike and the colour of the anthers are useful, while the arrangement of the sheaths on the axis, whether they are overlapping, merely touching or moniliform, is a relatively constant feature. The condition of the male flower when mature has been found to be a very valuable aid . . . The bracteoles may be retained in the open flower as in *C. lepidophloia* F. v. *M.* (recently found by the writer to be synonymous with the previously named *C. cristata* of Miquel), *C. distyla* Vent. *(C. rigida* Miq.), *C. paludosa* var. *robusta* Macklin, *C. paradoxa* Macklin, n. sp. *(vide* p. 150), *C. Muelleriana* Miq. and C. *Baxteriana* Miq. In few cases they are shed, leaving the mature flower consisting of one stamen and its sheathing bract, *e.g., C. stricta, C. Luehmanni* and *C. striata.* In *C. stricta* the two bracteoles are woody and cohere along the upper abaxial margin by means of branching hairs. The relative size of the persistent bracteoles to the sheathing teeth also appears to be constant, and can, therefore, rank among the more specific characteristics of the genus."

NOTES ON THE FLORA OF SOUTH AUSTRALIA.—No. 3.

By Ernest H. Ising.

[Read October 11, 1934.]

Casuarinaceae.

A review of certain species of *Casuarina* contained in an article (4) by E. D. Macklin gives information which will help in the diagnosis of this difficult genus. Amongst other details Macklin says:—"The following are the most important vegetative features: the angularity of the ridges, the size and nature of the sheathing teeth in each whorl and the length of the internodes. As regards the cones of the species dealt with in this paper, only the presence or absence of the dorsal protuberance of the valves and the degree of protrusion of the latter are worth consideration. The greatest assistance to taxonomic work . . . is to be gleaned from the male inflorescence. The average length of the male spike and the colour of the anthers are useful, while the arrangement of the sheaths on the axis, whether they are overlapping, merely touching or moniliform, is a relatively constant feature. The condition of the male flower when mature has been found to be a very valuable aid . . . The bracteoles may be retained in the open flower as in *C. lepidophloia* F. v. M. (recently found by the writer to be synonymous with the previously named *C. cristata* of Miquel), *C. distyla* Vent. (*C. rigida* Miq.), *C. paludosa* var. *robusta* Macklin, *C. paradoxa* Macklin, n. sp. (*vide* p. 150), *C. Muelleriana* Miq. and *C. Baxteriana* Miq. In few cases they are shed, leaving the mature flower consisting of one stamen and its sheathing bract, *e.g.*, *C. stricta*, *C. Luehmanni* and *C. striata*. In *C. stricta* the two bracteoles are woody and cohere along the upper abaxial margin by means of branching hairs. The relative size of the persistent bracteoles to the sheathing teeth also appears to be constant, and can, therefore, rank among the more specific characteristics of the genus."

The correct name, therefore, of one of our South Australian species is as follows:—

C. cristata Miq. Rev. Cas. 70, t. 10A (C. lepidophloia *F. v. M.*), Fragm. X, 115, 1877.

Chenopodiaceae.

Bassia All. Both Black (1) and Anderson (2) have found this a difficult and variable genus, and my recent study of it (3) has confirmed the views of these two. There is a diversity in the various parts of a species, and it is often necessary to widen the description to admit a new form which has been found. Variations occur in a number of the parts of a plant, the chief points of difference are in the number, position and size of the spines and in the vestiture, although the leaves vary too. The following notes add further details to known species, and one is definitely recorded for South Australia for the first time.

B. articulata J. M. Black, in these Trans., lvii. (1933), 150. I have a specimen from Pedirka (No. 2,859) collected on August 21, 1932, which differs from the type in the spines, 2 of which are 4½-6½ mm. long, one, which is always smaller than the others, is only 1½-3 mm. long, usually less than 3 mm.; there is sometimes a fourth spine present as a tubercle situated at the base of one of the larger spines.

B. ventricosa J. M. Black. A specimen (No. 2,889) collected at Curdimurka on August 19, 1932, has one spine 7 mm., one 5 mm., and a third about 1 mm.

long. Black's Flora (p. 191) gives the longest spines as 3-5 mm. in length. There is a specimen in the Tate Herbarium, from Mount Parry, June 4, 1883, having spines up to 8 mm. long.

B. eriacantha (F. v. M.) R. H. Anderson. At Pedirka a specimen was collected (No. 2,897) on August 29, 1932, which shows certain variations from the type, *viz.*, two tubercles besides the two spines are often present, Black (1) gives 2 spines and a tubercle and Anderson (2) records 3 spines occasionally; the two longest spines are villous to their summit and the base is not much oblique and is ovate to oblong.

B. quinquecuspis F. v. M. In sandhills at Pedirka, about 70 miles north of Oodnadatta, this species was collected in three locations, Nos. 2,885, 2,892 and 2,893, August 26, 1932. This is the *first record* for South Australia, although this name appears in the Flora of South Australia (1), *l.c.*, p. 194, the following note is appended:—"This species, common in the dryer parts of New South Wales and Queensland, has been found close to our eastern border at Milparinka and elsewhere, so that it must almost certainly occur in this State."

B. intricata R. H. Anderson. The collection of specimens at Wangiana (No. 2,663), Macumba (Nos. 2,671 and 2,672) and Pedirka (Nos. 2,869, 2,874, 2,883 and 2,895) *extend the now known range* about 400 miles further north. A specimen is in the Tate Herbarium, collected by E. G. Millard on the Warburton River, which is also known as the Diamantina River, another specimen came from Mount Nor'-west, 16 miles north-west of Farina.

B. patenticuspis R. H. Anderson. A specimen was collected at Snake Gully, near Pedirka (No. 2,903), on September 1, 1932, which appears to be a form of this species with a scanty vestiture of hairs giving the plant a different aspect; the spines are also more divergent; the leaves are up to 20 mm. long and the fruiting perianth is flattened.

B. lanicuspis F. v. M. *A slender form,* smaller in all its parts, was found at Bloods Creek (Nos. 2,863 and 2,864) on September 3, 1932. The different aspect of this plant, with its smaller fruits and leaves, distinguishes it from the typical form, but as other specimens connect this form with the type there is no justification for creating even a new variety. The average length of the leaves is from 5 to 6 mm. and of the spines from about 2 to 4 mm.

Threlkeldia inchoata J. M. Black. *Central Australia:* Coglin Creek, August 26, 1931, No. 2,930. This specimen was found just across the border and appears to be the *first record for Central Australia.*

T. proceriflora F. v. M. The occurrence of this species is given by Black (1), *l.c.*, p. 203, from two localities only, *viz.*, Mount Lyndhurst and Abminga Creek, which are separated by about 400 miles. I have collected this species at a number of places between these two points, as follows:—Callana, August 21, 1931 (No. 2,940); Macumba, September 1 and 5, 1931 (Nos. 2,938 and 2,939); Pedirka, August 22, 1931 (No. 2,936), and August 21 and 29, 1932 (Nos. 2,934 and 2,941); near Stevenson River, September 3, 1932 (No. 2,933); and Bloods Creek, September 3, 1932 (No. 2,942). All these specimens are more or less hairy.

Amaranthaceae.

Alternanthera denticulata R. Br. Specimens were collected at Abminga, August 22, 1931 (No. 2,456) and at Bloods Creek, September 3, 1932 (No. 2,947), both in our Far North, which is the *first record* north of the Flinders Range and extends its distribution by about 400 miles.

A. angustifolia R. Br. *Central Australia;* Wall Creek, just beyond our border, August 26, 1931 (No. 2,455), *first record* for Central Australia.

Trichinium nobile Lindl. Hitherto the farthest north record for this species has been the Flinders Range, but its range *is now extended* into the Far North

at Dalhousie Station (No. 2,959), September 6, 1932, and at Macumba (Nos. 2,422 and 2,423), September 1 and 5, 1931.

T. macrocephalum R. Br. Emery Range near Dalhousie Station, September 6, 1932 (No. 2,961), and Snake Gully, near Pedirka, September 1, 1932 (No. 2,962), both in our Far North. These two records create a gap of over 700 miles between the north and south localities for this species. The only previously known occurrence was in the South-East, from Bordertown southwards.

There is, however, a difference in published descriptions in connection with the ovary. Black's Flora of S.A. (p. 213) and Ewart's Flora of Victoria (p. 475) state the ovary to be pubescent; Bentham's Flora Austral. V. (p. 225) gives the ovary as glabrous, and I find that my specimens (as above) are certainly glabrous. I examined a specimen in the Tate Herbarium (Adelaide University) from Mount McIntyre, in our South-East, and the ovary is glabrous with sometimes a very scanty pubescence observable. Bentham examined specimens from Queensland, Victoria, and New South Wales.

T. semilanatum Lindl. A specimen was collected at Pedirka, August 30, 1932 (No. 2,964), having the older flower heads developed into cylindrical spikes up to 4 cm. in length. Bentham's description (5), however, definitely states "heads at length globular." The Pedirka specimen reveals other divergences from the above description in that the perianth segments are unequal, the two outer being longer than the three inner and the ovary is often glabrous or nearly so, with a style less than half the length of the flower.

Ptilotus latifolius R. Br. This rare plant was found in *Central Australia* at Horseshoe Bend, August 23, 1931 (No. 2,417). Ewart (6) states that it is recorded in the Melbourne National Herbarium census as from North Australia, but it is shown under the name of *Trichinium*, which is evidently an oversight for *Ptilotus*. There are specimens in the Tate Herbarium as follows:—*Central Australia:* Idracowra, May 23, 1895; latitude 23·50°, longitude 129·35°, which is near the Western Australian border; *South Australia:* Blanchewater, which is 85 miles east of Marree.

CRUCIFERAE.

Stenopetalum nutans F. v. M. This somewhat rare plant I collected in our Far North at the following localities:—Abminga, August 27, 1931 (Nos. 2,497 and 2,499); Snake Gully, September 1, 1932 (No. 3,054); Pedirka, August 28, 1932 (Nos. 3,055 and 3,056). The localities from which it was previously known, as recorded by Black (*l.c.*, p. 255), are near Cooper's Creek and the Musgrave Range. The former is in the north-east part of the State, and the latter in the north-west, and my localities, as shown above, occur in the country between, thus spanning a 700-mile gap across the State. The pods, besides having one central nerve on each valve, are reticulate-veined also.

REFERENCES.

1. J. M. BLACK, Flora of South Australia (1924), 190.
2. R. H. ANDERSON, Proc. Linn. Soc. New South Wales, xlviii. (1923), 328.
3. E. H. ISING, these Trans. lvii. (1933), 91 and 181.
4. KEW BULLETIN (1931), 145.
5. G. BENTHAM, Flora Australiensis, v. (1870), 227.
6. A. J. EWART, Flora of the Northern Territory (1917), 100.

ON MAMMALS FROM THE DAWSON AND FITZROY VALLEYS; CENTRAL COASTAL QUEENSLAND.-PART II.

BY *H. H. FINLAYSON*

Summary

In a richly forested tract of equable climate, supporting many arborescent species which bloom freely at rather widely-spaced intervals, one may confidently look in Eastern Australia to a generous representation of this arboreal family. In the area of coastal Queensland now under consideration, all three types of alimentation of the phalangers are lavishly catered for, and phytophagy, insectivority, and nectar-sipping are simultaneously possible throughout a large part of the year.

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By H. H. Finlayson,
Hon. Curator of Mammals, South Australian Museum.

[Read October 11, 1934.]

Phalangeridae.

In a richly forested tract of equable climate, supporting many arborescent species which bloom freely at rather widely-spaced intervals, one may confidently look in Eastern Australia to a generous representation of this arboreal family. In the area of coastal Queensland now under consideration, all three types of alimentation of the phalangers are lavishly catered for, and phytophagy, insectivority, and nectar-sipping are simultaneously possible throughout a large part of the year.

While this leads to a numerous representation both of species and individuals, it is, nevertheless, noteworthy that all the forms which occur here have an almost uninterrupted distribution throughout the Eastern forest tract, from Cape Otway in the south, far up into the Cape York Peninsula, without loss of specific identity. The extreme northern and southern representatives of these species can frequently be distinguished as distinct subspecies, and it may be, that true geographical races with circumscribed ranges may yet be brought to light by systematic collecting, but in most cases the passage from north to south effects so gradual a change that the use of trinomials in middle Queensland is subject to a good deal of uncertainty.

This is increased by the lamentable neglect to describe seasonal changes in the pelage of mammals, which is so considerable in some of the species here listed as to undermine one's faith in the significance of the slight differences which have been recorded as distinguishing some so-called varieties.

The typical Torresian forms, such as *Dactylopsila* and the jungle *Pseudochiri* characteristic of the more tropical conditions further North, are absent from the area.

In this and the succeeding families most of the specimens reviewed were taken in the low-lying country of the lower Fitzroy Valley, north of Rockhampton, and not in the Dawson Valley proper, but comments on distribution and status apply to both watersheds.

Pseudochirus laniginosus oralis (Thomas).

As in most parts of their joint range, the "ringtail" here is much less numerous than *Trichosurus*, but is almost equally ubiquitous and was observed from Spring Creek, near Taroom, in the south, to the Serpentine Creek, in the north. The series examined comes entirely from the latter locality and is possibly not strictly typical of the area as a whole.

Owing to its short coat it is of little value to furriers, but large numbers are killed during open seasons owing to the impossibility of discriminating effectively between ringtails and brushtails in snaring, trapping and shooting. Its habits appear to be much as in the South, except that nest-building in the lower growth seems to be less frequently resorted to.

Unlike *Trichosurus*, the local *Pseudochirus* is very constant in its pelage characters, and except for an increased density the winter coat is exactly like the summer one. In its clear grey dorsal colouration with strongly contrasted "orange

cinnamon" limbs, it is in good agreement with Thomas's var. *oralis*(1) from a point about 300 miles north of the location of my series. Thomas, however, states that the head in *oralis* is "dark grey, but little more tawny round eye." In the present series the facial area is pretty uniformly a pale buff grey to the crown and the eyes are prominently conspicillate with cinnamon.

No reliable flesh measurements are available, but the tail appears to be decidedly longer and more slender than in the southern races of this species, and distally it is white for more than half its length. Thomas's measurement of 53 mm. for the pes is evidently a misprint for 35 mm.

The skulls show constantly a series of not unimportant features which serve to distinguish *oralis* from the southern races. Thus (1) the muzzle region is heavier, with longer nasals which taper evenly forward with their outer margins straight and not concave, so that each bone is evenly wedge-shaped; (2) the interorbital region is less constricted (7·6 : 7·1); (3) the anterior palatine foramina and palatal vacuities are larger; (4) P^4 is smaller in *oralis* (2·8 : 3·3 mm.); (5) the upper molar series is shorter—attaining a maximum of 14 mm. as against 14·5.

In making these comparisons I have had to rely on series derived largely from western Victoria and south-eastern South Australia. If it can be shown that the differences are equally marked when the comparison is extended to true *laniginosus* of New South Wales and south Queensland, the separation of *oralis* as a full species might be justified, though it is obviously very closely related to *laniginosus*.

This appears to be the only species of *Pseudochirus* in this part of Queensland.

Skull dimensions of the largest ♂:—Greatest length, 59·8; basal length, 54·4; zygomatic breadth, 34·5; nasals, length, 21·7; nasals, greatest breadth, 11·0; P^4, 2·8(2); upper $M^{s\,1-4}$, 13·5.

Seven skins and skulls examined.

PETAUROIDES VOLANS INCANUS (Thomas).

A common species in open eucalyptus parks over the whole of the Dawson Valley and the lower Fitzroy, and as little if any commercial use is made of the pelt, the "accidental" killings during opossum seasons seem to be the only causes of mortality on any large scale, and it is likely to persist as long as the timber stands. Nine specimens examined, all from the Serpentine Creek area.

These form a fairly uniform series, though the single mid-summer skin conspicuously lacks a brownish tinge which is noticeable in the dorsal fur of the remainder, which were taken in mid-winter. They agree with Thomas's variety *incanus*,(3) and differ from most examples from Victoria and southern New South Wales, in their lighter, more grizzled, dorsal body colour, which leaves the brownish-black outer aspects of the ears and limbs in stronger contrast than in the typical variety, and in the much lighter colour of the tail, which is black for its distal third only, or even less, the colour fading proximally through shades of brown and greyish-brown, to the paler slaty-grey of the basal portion. Ventrally, however, none of my skins are "whitish," but range from a decided cream to a pale buff.

Although easily distinguished from most examples of *typicus* from the southern parts of its range, it is significant that the changes which culminate in

(1) Ann. Mag. Nat. Hist., ser. 9, vol. xvii (1926), p. 631.

(2) Tooth measurements, unless otherwise stated, apply to the upper series.

(3) Ann. Mag. Nat. Hist., ser. 9, vol. xi., p. 247.

the *incanus* and *minor* characters are initiated at least as far south as the Strathbogies in Victoria, where grizzled individuals are sometimes met with, and in southern New South Wales the light tail base occurs in a large proportion of individuals. Thomas states that one-third of his examples showed pigmentation deficiencies in the fur of head and tail, but so far as I can ascertain, the beautiful pale phase of southern New South Wales,(4) in which the whole dorsum becomes a nearly uniform smoke grey, does not occur in the Dawson Valley.

I have no specimens from Coomooboolaroo, whence came the so-called variety *armillatus* of Thomas. That place, however, lies between the type locality of *incanus* and the Serpentine Creek area which afforded the present series of *incanus,* and there is little in its physiography or vegetation to provide sufficient ecological change to account for the abrupt appearance of another form in so restricted an area. *Armillatus* I judge to be founded on a slightly stunted example of *incanus.*

The following dimensions, derived from freshly-killed adult animals, relate to: (1) a male of *incanus* from the lower Fitzroy Valley; (2) a male of *typicus* from the Tumut district of New South Wales, 900 miles south of the first locality; and (3) the range in six females of *typicus* from the same place.

Head and body, 390, 410, 395-440; tail, 460, 480, 485-530; pes, 50, 56, 52-56; ear, 43 × 28, 44 × 27, (44 × 22) — (46 × 31); weight, ————, 1,000 grammes, 890-1,335 grammes.

Skull dimensions of the largest *incanus* male taken:—Greatest length, 61·3; basal length, 55·1; zygomatic breadth, 39·8; nasals, 15·9 × 10·5; palate, breadth inside M^2 (at ant. angle), 11·6; constriction, 7·1; palate, length, 31·8; anterior palatal foramina, 6·7; basi-cranial axis, 19·0; basi-facial axis, 36·4; P^4, 2·3; Ms^{1-3} (upper), 11·0.

Phascolarctos cinereus adustus (Thomas).

The tenure of the koala in the Dawson Valley seems to have been a waning one for many years, and the last open season reduced it to such an extent that it is now a rare animal in many parts of the valley where it was formerly very plentiful. The process has been hastened, too, in some places, by an epidemic, and on Coomooboolaroo in the summer of 1929 several were seen in comatose condition at the base of feeding trees. The single example in this condition which was examined closely was an aged male, and though emaciated was not heavily infested with endoparasites, nor obviously diseased organically.

Here, as in the south, is has a marked preference for open eucalyptus parks, and shuns scrubs. Its chief feeding trees are the lemon-scented gum *(E. maculatus citriodora)* and the Moreton Bay Ash.

It was observed and collected at Thangool on the Cariboe, at Coomooboolaroo, and near Mount Hedlow, on the Fitzroy.

Thomas's variety *adustus*(5) was based on an animal from Mundubbera, on the Upper Burnett, about 100 miles from my Thangool specimens and in similar country. The five specimens obtained agree with Thomas's description moderately well and differ from Victorian animals in their shorter coat, duller colouration, and smaller size. These differences, however, although marked in some specimens, are subject to much variation. The skull, also, does not seem to be *proportionally* smaller than in the southern animal, as might be inferred from Thomas's account. A longer ear seems to be a constant attribute in *adustus,* but the relative nakedness mentioned by Thomas is not a good character —some

(4) The light phase of *var. minor,* mentioned by Collett (Zool. Jahrb., Band II., 1886-1887), is evidently much less completely bleached than in this form.

(5) Ann. Mag. Nat. Hist., ser. 9, vol. xi. (1923), p. 246.

examples having the ear as heavily furred as is usual in the south. Nor is there a conspicuously rufous suffusion in any of the five skins examined. Seasonal change slight.

The following are the flesh dimensions of a ♂ and ♀, both aged, from the Dawson Valley:—

Head and body, 665, 635; pes, 90, 82; ear, 73 × 58; 68 × 55; weight, 14 lbs,. 12 lbs.

Skull dimensions of this ♂ are:—Greatest length, 139·2; condylo basal length, 129·1; zygomatic breadth, 80·1; nasals, 37·2 × 40·1; constriction, 23·5; palate, length, 66·5; palate, breadth inside M^2 (at ant. angle), 20·1; ant. palatal foramina, 3·6; basi-cranial axis, 41·5; basi-facial axis, 84·0; P^4, 7·2; $M^{s\,1\text{-}4}$ (upper), 28·2.

The skull is less massive than in similarly aged individuals from Victoria, but does not differ structurally in any important way. The teeth are proportionately larger, however, having the same dimensions as in the larger southern skull.

In view of the even distribution of the koala (until recently) throughout all the East Coast lands from the 19° to 39° parallels, and the general similarity of the forest country which it selects, it does not seem probable that the mid-Queensland animal should constitute a distinct race, abruptly differing from its neighbours to the south. The few examples of the New South Wales representative which I have examined, seem to me to be quite intermediate between Victorian and Queensland ones, and I have no doubt that a series adequately representing the whole of its range would show a steady gradation of characters—the passage from south to north being accompanied by a decrease in average size, dulling of colouration and (at similar altitudes) shortening of the coat.

Thomas does not list the specimens which he examined, but evidently considers that *adustus* continues as far up the coast as Inkerman, 500 miles north of Mundubbera. If this is so, it is a matter for regret that the former place was not made the type locality, since if this is the northern limit of the range of *Phascolarctos,* it is probably also the point at which its distinction from the southern animal reaches its maximum.

ACROBATES PYGMAEUS (Shaw).

Four specimens from the lower Fitzroy, within 30 miles of Rockhampton, where it is still, as in Lumholtz's time, fairly plentiful.

Of these only two (a skin and skull and a spirit specimen) are in sufficiently good condition for comparison with southern material, and so far as pelage and general external characters go, they agree closely with examples from Victoria and south-eastern South Australia.

In seeking parallels for what was at first thought to be an anomaly in one Queensland specimen, I have been struck with the wide variation which occurs in the surface appearance and arrangement of the sole pads in series of *Acrobates* from quite restricted areas. The varying degrees of desiccation and distortion which take place in material preserved in alcohol of differing concentration, make it difficult to define these features except with fresh material, but two distinct conditions seem to exist. In one (the more frequent), 3 true interdigital pads are present, which, though somewhat amorphous in themselves, are surmounted by a well-defined, bluntly oval or rotund tubercle showing obscure concentric striation.

In another type the 3 interdigitals give place to 4 basi-digital elevations, or even to one irregularly-shaped cushion, which is surmounted by 4 very elongate tubercles converging slightly towards the centre of the sole. The apical, thenar and hypo thenar pads and tubercles are more constant, but the depth and pattern

of the striation varies considerably, as does the degree of granulation of the low-lying areas of the sole and under-surface of digits.

Dimensions of an adult ♀ from the Serpentine Creek area (measured in alcohol) :—Head and body, 65; tail, 80; pes, 13; ear, 9·5.

Skull of another, slightly immature:—Greatest length, 20·0; basal length, 17·1; zygomatic breadth, 12·7; nasals, length, 7·0; interorbital breadth, 4·5; palate, length, 9·8; M^{s1-3} (upper), 2·7.

No specimens of *Dromicia* nor of *Eudromicia* were taken, nor any reliable records of their presence in the area obtained.

Petaurus australis reginae (Thomas).

Three specimens from the Rocky Water Hole in the Serpentine Creek, about 28 miles north-east of Rockhampton. This *Petaurus,* although much scarcer than *Petauroides,* is yet a fairly common animal on the Dawson and Fitzroy, and is much more plentiful in this part of Queensland than either *sciureus* or *breviceps.*

The three examples are adult females and agree with Thomas's var. *reginae.*(6)

Two specimens from Herberton, 600 miles further north, which I have compared with them, are larger, much darker and more richly yellow, and externally appear to be closer to the typical race than the Fitzroy ones, in spite of their geographical remoteness.

In the three *reginae* females, head and body range from 280-290, and tail 400-450.

The range of skull dimensions is:—Greatest length, 52·5-55·0; basal length, 44·9-47·9; zygomatic breadth, 36·9-37·8; nasals, (18·9-19·9) × (11·8-12·3); constriction, 10·2-10·5; palate, length, 25·8-26·0; palate, breadth inside M^2 (anterior angle), 10·4-11·1; P^4, 2·0-2·5; M^{s1-3} (upper), 7·0-7·3.

Petaurus sciureus (Shaw) var. ?.

A single specimen from the Serpentine Creek area. Mr. Vallis, who captured it and who is well acquainted with its nearest allies, states that it is a very rare form here, but as very few bushmen discriminate between it and *breviceps* it is difficult to get any reliable information on its distribution.

Lumholtz found it "not uncommon" in 1882-1884 somewhat further north, and made the curious statement that, "like *Phalangista vulpecula,* it visits the lowlands only in winter and disappears entirely in summer." I have not been able to get any evidence in support of such a seasonal movement for any of the *Phalangeridae* in this part of Queensland. *T. vulpecula* was as plentiful on the low-lying lands as it was on the plateaus, in the mid-summer of 1929.

The single specimen (♀), judged by the sutural conditions of the skull, is slightly immature, but it evidently represents a rather smaller race, which differs from the New South Wales *typicus* besides, in having a much less bushy tail and more fulvous colouration particularly on ventrum. The metacarpus and digits are pale buff and rather strongly contrasted with the forearms.

It is extraordinarily similar in external characters to *P. breviceps ariel.* In the south the pure white belly fur and much bushier tail and larger size, generally suffice to distinguish the typical *sciureus* from typical *breviceps,* but the northern forms appear to be practically identical in all external features except that of size.

The skull, however, in addition to its larger size, has a relatively longer and more conical muzzle than *breviceps,* a higher facial index, less expanded nasals, more evenly spaced premolars, and distinctly heavier upper molars. The last is a critical distinction.

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(6) Ann. Mag. Nat. Hist., ser. 9, vol. xi., p. 249.

Dimensions (in flesh):—Head and body, 187; tail, 253.

Skull:—Greatest length, 44·3; basal length, 38·8; zygomatic breadth, 29·9; nasals, 15·0 × 6·8; intertemporal, 8·8; palate, length, 23·1; palate, breadth inside M^2 (ant. angle), 7·9; basi-cranial axis, 14·0; basi-facial axis, 26·2; facial index, 187; P^4, 1·8; Ms^{1-3}, 6·8.

It is possible that the present animal is identical with De Vis's *Belideus gracilis*[7] from north of Cardwell, though that animal (referred to *P. sciureus* both by Thomas in 1888 and Longman in 1930) appears to be even larger than the typical variety.

PETAURUS BREVICEPS ARIEL (Gould).

Widely spread but not a common animal in any part of the area. Five specimens in winter coat from the Serpentine Creek area, examined.

In separating the Papuan representative of *Petaurus breviceps* from that of the Australian mainland, O. Thomas, in 1888, merged Gould's *P. ariel*, from Port Essington, with the typical variety, thus taking no cognisance (in nomenclature) of the very considerable and evidently constant differences which separate the North Coast animal from that of New South Wales and Victoria. I have not examined specimens which are reliably localized on the North Australian coast, but three examples from Melville Island and three from Groote Eylandt, in the South Australian Museum agree closely with Gould's description and plate, and differ constantly from New South Wales, Victorian, and South Australian examples in that: (1) the dorsal coat is shorter, its general colour lighter and more fulvous, and the dorsal stripe is more prominent and extends from the coronal gland patch to the sacrum or beyond; (2) the belly fur is coloured a clear pale yellow, and there is no trace of the dark subterminal band which is responsible for the grey belly in the typical animal; (3) the black portion of the tail is rather sharply differentiated from the lighter proximal portions; (4) bodily size is distinctly smaller, with a smaller skull and greater degree of interorbital constriction.

These differences seem to demand the retention of Gould's name in subspecific form for the North Coast animal.

The animal from the Rockhampton district is to some extent intermediate between *ariel* and *typicus*, but is closer to *ariel* and in particular completely lacks the dark subterminal band on the belly fur which is yellow throughout though somewhat more ochreous than further north. The distinctions do not seem to me to call for another trinomial.

I am unable to give reliable flesh measurements, but the following values derived from three males in formalin would indicate that the general bodily size is not conspicuously smaller than in the south, nor, when allowance is made for contraction, are the ear and pes:—

Head and body, 160-175; tail, 200-215; pes, 24-25; ear, 25-27.

One skull only has been examined—an adult ♂. It is considerably smaller than the largest *typicus* males and has slightly lighter molars, but is otherwise identical.

Basal length, 32·2; zygomatic breadth, 26·5; nasals, 10·8 × 6·1; interorbital constriction, 8·2; palate, length, 18·7; breadth, inside M^2 (ant. angle), 6·7; P^4, 1·5; Ms^{1-3}, 5·2.

Longman's var. *longicaudatus*,[8] from the eastern shore of the Gulf of Carpentaria, is geographically nearer to the locus of the present series than is the type locality of *ariel*, but the variability in length of tail which can be demonstrated in the south, is so great that, in the absence of other data, its distinction from *ariel* seems rather doubtful.

(7) Proc. Linn. Soc. N.S.W., vol. vii. (1888), p. 619.

(8) Proc. Roy. Soc. Qld., vol. xxxvi., p. 9.

Trichosurus vulpecula typica (Kerr).

An open season for opossums had been declared a few months prior to my arrival in the area, and many thousands had been taken by trappers, but the animal was still very abundant and widespread. It seems to be equally at home in all types of timbered country, Coolibah flats, Moreton Bay Ash belts, Ironbark plateaus, and even Brigalow scrubs, where these are interspersed with groups of Blackbutts, but the wet vine and soft wood scrubs are evidently not attractive to it.

O. Thomas[9] has already assigned specimens from Westwood, near Rockhampton, to the typical variety, and as the most northerly of my specimens is from about 20 miles north of that town, a similar agreement with the southern animal was to be expected. The Dawson Valley opossums vary within rather wide limits, but all the colour phases shown can be closely matched with animals from New South Wales, Victoria, and the South Australian mainland. The seasonal change in the coat, however, is more pronounced than in the south, and summer skins are normally very dilapidated and thinly furred, with a scanty brush. The dorsal colour in this condition is a pale ash grey and the fur is lifeless and dull, without the crispness and sparkle of the winter coat.

These summer phases are very similar indeed to the so-called subspecies from the north—*arnhemensis* of Collett and *eburacensis* of Lonnberg and Mjöberg, the seasonal variation of which has never been defined. The differences which separate Thomas's *mesurus* from Inkerman from the present animal also seem to be vanishingly small.

The *average* size of the species on the Dawson appears to be distinctly less than in Victoria and South Australia.

Flesh dimensions of a mature female from Thangool:—Head and body, 415; tail, 315; pes, 66; ear, 54 × 29.

The largest skull (doubtfully sexed) has:—Greatest length, 87·8; basal length, 80·6; zygomatic breadth, 51·7; nasals, 33·9 × 17·0; constriction, 7·8; palate, length, 46·0; palate, breadth inside M^2 (ant. angle), 16·0; ant. palatal foramina, 6·3; P^4, 4·8; $M^{s\,1-3}$, 15·1. Eight complete skins, 11 skulls and some hundreds of pelts examined.

Phascolomyidae.

In 1929, Mr. A. S. le Souef, of Taronga Park, Sydney, drew my attention to a belief that wombats were extant in central coastal Queensland. On investigation, however, this proved to be due to the misapplication of the word wombat to *Thalacomys lagotis* in the Clermont district.

No member of this family seems to have occurred in the area in recent times.

Dasyuridae.

In common with the *Peramelidae*, and indeed with most other small terrestrial or partly terrestrial mammals, the members of this family in the Dawson Valley underwent a sudden diminution in the late eighties of last century, and though some species have made brief recoveries from time to time, they have not persisted, and at the present time are reduced to vanishing point. The specimens reviewed in the sequel have mostly come from a small coastal area on the Fitzroy, but whether this indicates that this area has escaped the depleting influence or whether it is at present at the peak of a restoration period, I am unable to say.

The real nature of the causes underlying these declines is obscure, owing partly to the absence of reliable contemporary records covering any considerable area. In different parts of the country floods, fires, droughts, disease, and closer settlement are all confidently advanced as having been severally responsible, and

(9) Ann. Mag. Nat. Hist., ser. 9, vol. xvii., p. 635.

no doubt they have all contributed. But it is significant that the first notable diminution took place at a time when the country was still very sparsely occupied, and secondly, that the causes have been highly selective, since the *Macropodidae* and *Phalangeridae* have fluctuated within much narrower limits than the *Dasyuridae* and *Peramelidae.*

Mr. H. Barnard states that, after years of rarity, bandicoots of two species became very plentiful on Coomooboolaroo in 1895, but that in 1897 not one could be found. And again, in 1905, *D. geoffroyi (+ D. hallucatus ?)* was noticed to be suddenly numerous, but it completely vanished by 1906. The possibility of migratory waves accounting for such occurrences must not be overlooked, but although the element of *regular* periodicity is evidently lacking, there is yet something in these records suggestive of the rise and fall of the rodent populations of subarctic lands, and it may be that behind the complex of disturbing factors introduced by European settlement there is some much more fundamental cause which determines the numerical status of marsupial species at any one time. Recent experience in South Australia seems to support this idea, since two species, *Isoodon obesulus* and *Phascogale flavipes,* after 30 years of obscurity, have suddenly greatly increased in numbers in districts which are comparatively closely settled, and indeed in one case almost suburban.

Dasyurus hallucatus (Gould)

Two specimens only; one from Cooti Uti on the coast, about 100 miles north of Rockhampton, and one from the outskirts of the town itself.

I find it impossible to refer either of them with any confidence to any of Thomas's[10] four subspecies, and though they come from localities so little sundered and presenting similar conditions, they differ widely from one another in dimensions and colouration. Both are fully adult males taken in winter. The Cooti Uti specimen has the *typicus* colouration, but the tail is longer, very short-haired, and darkens gradually to a brownish terminus without forming a brush. Its flesh dimensions greatly exceed those of the Port Essington *typicus,* and even the large *predator* of Cape York Peninsula.

The Rockhampton specimen is smaller and much darker dorsally; the white spots on the foreback and walls of the thorax resting upon a blackish slate ground. This, however, seems to be due to a partial melanism, as an abruptly limited black area is present on the muzzle and involves the upper lip. The tail is incrassated and has the curious radish-shape characteristic of *Sarcophilus.* It is quite well furred, and the distal half is nearly black and long-haired. The tail in both specimens terminates in a small, slender, horny spur, 3 mm. long.

In manus and pes both show the characteristic striate pads of *hallucatus,* but the surrounding naked areas are not smooth but highly granular, as in *geoffroyi.* The smoothness of the palmar and plantar surfaces encircling the pads was held by Gould, Waterhouse, and Thomas (in 1888) to be a good distinction of *hallucatus* from *geoffroyi.* Pocock,[11] in his account of the external characters of some *dasyuridae,* does not single this character out for unequivocal mention in the text, and his figure is indefinite, nor does Thomas mention it in the subdivision of the species cited, but the evidence of these two specimens leaves no doubt that this also is a variable feature.

The skulls resemble one another very closely; that of the smaller animal being slightly the larger. In their dimensions they come nearest to the var. *predator,* of Cape York, but even if their external characters would allow it, it

(10) Ann. Mag. Nat. Hist., ser. 9, vol. xviii. (1926), p. 543.

(11) Proc. Zool. Soc. London, 1926.

is difficult to assign them to *predator*, since Thomas's record of true *hallucatus* from Inkerman interposes another race between the two localities.

The present record extends the range of *hallucatus* on the mainland nearly 500 miles south, but in view of the great variation shown by the two examples in the restricted area from which they have come, it would be absurd, without much more material, to introduce yet more names to distinguish this southern animal from its neighbours. Most of the characters relied on by Thomas to separate the four "races" seem to be susceptible to individual, seasonal, and age variation, and with the added evidence of these two anomalous southern specimens, the conception of a single variable form extending over the coastal districts from Port Essington to Rockhampton seems to be more in harmony with the facts.

Dimensions (in alcohol) of (1) adult male from Cooti Uti and (2) adult male from Rockhampton:—Head and body, 320, 260; tail, 285, 265; pes, 48, 50; ear, 32, 36.

Skull dimensions of the same:—Basal length, 67·0, 69·2; zygomatic breadth, 40·0, 40·5; nasals, (22·2 × 10·2), (24·0 × 10·5); intertemporal, 9·4, 10·1; palate, length, 34·8, 37·0; palate, breadth inside M^2 (at ant. angle), 11·2, 12·0; ant. palatal foramina, 4·0, 4·0; basi-cranial axis, 21·2, 24·0; basi-facial axis, 40·0, 42·0; P^3, 3·0, 3·0; Ms^{1-3}, 12·8, 12·9.

Of the other species of *Dasyurus*, both *maculatus* and *geoffroyi* have been recorded from this portion of Queensland, and both were evidently fairly common animals until the eighties. *Maculatus* is now a very rare form, though two examples were credibly reported to have been taken in the Berserker Hills as late as 1929. *Geoffroyi* was taken on Coomooboolaroo by Lumholtz in 1884, and it may still persist there, Mr. C. Barnard having killed a native cat which he refers to this species, in the pantry of the homestead in 1930. Since *hallucatus* and *geoffroyi* may easily be confused, and as I have no specimens of the latter, I cannot record its presence in the area with any certainty.

Phascogale penicillata pirata (Thomas).

A single specimen from the Serpentine Creek, taken in mid-winter. The animal appears to be very rare on the Dawson but still has a good hold on the wetter coastal country of the Fitzroy, though it is seldom seen. Mr. Vallis informs me that he has more than once seen this animal and the local *Dasyurus* feeding at night on the carcass dumps near snaring camps, but whether the *Phascogale* is attracted thence by the carrion or its infesting larvae is a moot point. Mr. Fleay,[12] in his interesting account of this species in captivity, records his opinion that it does not eat carrion, as some of its allies certainly do. The specimen is an aged male, and I refer it to Thomas's *pirata*,[13] chiefly on the evidence of its dentition. It is distinctly, though not markedly, smaller than similarly aged males from the Mount Lofty Range of South Australia, but its smaller pes (35:43) is a more tangible distinction. The coat is shorter and somewhat crisper than in the south, but the general colour is not lighter, nor is the buffy sub-basal zone of the tail much more conspicuous than it frequently is in Western and South Australia.

The skull is nearly as large as that of the typical variety, and its single structural distinction seems to lie in the greater width of the nasals. I have not been able to observe the alteration in proportion of incisors and lower premolars, detected by Thomas in the Alligator River specimens, but the entire dental series

(12) Victorian Naturalist (1934), Aug., p. 89.

(13) O. Thomas. Novit. Zool. xi. (1904), p. 228.

is very markedly reduced, and the molars in particular are much slighter. Occurring in skulls of the same general size this characteristic of the teeth is a conspicuous one and, with the shorter foot, justifies the use of a trinomial for the northern animal in spite of its extraordinary external similarity to the typical form.

Dimensions of an aged male (in alcohol):—Head and body, 181; tail, 196; pes, 35; ear, 30.

Dimensions of skull of same male:—Greatest length, 48·1; basal length, 44·1; zygomatic breadth, 28·3; nasals, 18·4 × 7·8; intertemporal, 7·1; palate, length, 26·1; ant. palatal foramen, 4·1; P^4, 1·5; $M^{s\,1-3}$, 8·3.

PHASCOGALE MINUTISSIMA (Gould).

Four adults and five young examined; all from the Serpentine Creek area, where apparently it is the only pouched mouse at all well known. It builds a little grass nest, frequently under logs and in termite mounds. Of the two females, one taken in April, had three naked embryos, and the other in June, was accompanied by five fully furred young with a head and body length of 50 mm. each. I have no reliable information on its distribution further south in the Dawson country.

Two distinct dorsal colourations are represented; one female with her litter of five half-grown young, having a rather cold greyish-brown tone, and the three other adults (two ♂ and ♀) a much richer reddish-brown, particularly about the head. The degree of grizzling is about the same in both and the colder tone may be an immature character. Ventrally the fur is pale buffy externally, slate basally, and there is no sign of maculation in any specimen. Gould's plate of *minutissima* seems to be misleading as to dorsal colour, as it is supposed to represent an animal stated in the text to be "brown, grizzled with black." It is much paler than any of my specimens, which are (dorsally) much nearer his plate of *maculatus*.

In foot structure and other external characters the series is constant, and with two skulls which have been extracted agree well with Thomas's description of the typical animal in the B.M. catalogue, though I have not been able to test their possible relation to his *sinualis* from Groote Eylandt by direct comparisons. From *P. ingrami brunneus* (Troughton) and *P. tenuirostris* (Troughton), the only other closely related forms which have been described from Eastern Australia, my specimens are clearly distinguished by (1) larger body size; (2) constant presence of seven sole pads with distinctly transverse striate tubercles; (3) slate and not brown underfur; (4) larger skull with greater vertical depth from basion to crown.

The largest male and female (measured in alcohol and somewhat contracted) have:—Head and body, 78, 75; tail, 55, 61; pes, 10, 10.

Skull of adult ♀:—Greatest length, 19·4; basal length, 17·9; zygomatic breadth, 10·3; nasals, 7·5 × 2·6; interorbital, 4·2; palate, length, 9·8; palate, breadth inside M^2 (at ant. angle), 3·2; P^4, 6 ca.; $M^{s\,1-3}$, 3·7. Height from basion to crown, 4·8.

SMINTHOPSIS CRASSICAUDATUS MACROURUS (Gould).

A single specimen, adult male, from the Serpentine Creek.

In full winter pelage this example can be exactly matched in colouration by examples from the lower wetter districts of South Australia and from Western Victoria, which themselves are not definably different in this regard from the true *crassicaudatus* of south-west Western Australia. In the Serpentine Creek specimen the dark pigmented-antero external zone of the ear is particularly well marked and, moreover, it differs from all wet country specimens I have hitherto

examined in possessing a black stripe extending with increasing width from a point 2-3 mm. short of the rhinarium, to the crown. Being bordered on either side by much lighter facial areas the mark is very conspicuous, much more so than in *crassicaudatus centralis,* where a similar though less extended feature sometimes occurs, or in *larapinta* where it is normal.(14) The tail also is longer than in any other coastal specimen I have examined.

The interdigital pads of manus and pes differ from the condition in west Victorian and lower South Australian animals in being surmounted by distinct, though small, unstriate tubercles, and the outer carpal (hypothenar) pad of the manus is shod with a large, smooth ridge more distinctly Λ-shaped than in the south.

Gould's *Podabrus macrourus* (15) was based on an animal from the Darling Downs, 400 miles south, which also possessed a well-marked median facial stripe and longer tail (16) than is usual in the south and south-west.

Although I have not examined the skull and the constancy of the characters of the foot pads remains to be ascertained, it seems advisable to retain *macrourus* provisionally as a trinomial for this north-eastern coastal representative of the species, noting however that the differences which separate it from *typicus* are much slighter than with the variety *centralis.*

S. crassicaudatus was not taken by Lumholtz in 1882-1884, nor apparently by any subsequent collector in coastal Queensland, since Longman in 1930 lists it only from south-west Queensland, where the prevailing form is the long limbed, pallid *centralis.* The present specimen, therefore, from about 28 miles north-east of Rockhampton, is a northerly record for the species on the east coast, and extends its coastal range some 400 miles.

Dimensions of adult male (in alcohol):—Head and body, 77; tail, 71; pes, 15·5; ear, 15·0.

PERAMELES NASUTA TYPICA (Geoffroy).

Four specimens from the Serpentine Creek area where it is not uncommon, though greatly outnumbered by the local *Isoodon.* I cannot throw any light on the bionomic relations of the two genera in Queensland from personal observation, but Mr. Vallis states that whereas *Isoodon* is ubiquitous, *Perameles* is more often got in the dense growth on the slopes of the ranges. This differs from the zoning of the two genera in Tasmania, where in my experience *P. gunnii* is largely a grass or open country form, whereas *I. obesulus,* though ubiquitous, is commoner in scrubs and under heavy timber. There is, however, a great deal of overlapping, and it may be doubted whether either of the genera is decidedly adapted to any one type of habitat, as Gould thought.

In winter coat the four examples are rather more decidedly grizzled than in the examples of the New South Wales animal which have been available for comparison, and the yellow element in the colouration is rather more pronounced, but the markings of limbs, characters of appendages, and skull agree well, and the dimensions evidently vary over about the same range.

Two of the examples resemble *I. macrourus torosus* quite closely in pelage, but all can be distinguished by the narrow irregular belt of pale vinous colouration which intervenes between the grizzled sides and the white belly—evidently a constant feature in *nasuta.*

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(14) In *crassicaudatus centralis* it is chiefly the coronal portion of the stripe which persists, and in *larapinta* the interorbital, but it may be quite absent from both.

(15) Proc. Zool. Soc., 1845, p. 79.

(16) Thomas, however, records an example from Queensland in which the tail is much shorter. B.M. Catalogue (1888).

Thomas's var. *pallescens* has not been examined, but is evidently a much paler and less grizzled animal than the present form.

Approximate flesh dimensions of three adult males:—Head and body, 340-416; tail, 147-173; pes, 70-77; ear, 42-46.

Skull of largest male:—Greatest length, 86·9; basal length, 78·0; zygomatic breadth, 36·8; nasals, 38·7 × 5·7; intertemporal, 13·7; palate, length, 49·6; palate, breadth inside M^2 at anterior angle, 14·1; anterior palatal foramen, 6·9; basi-cranial axis, 21·9; basi-facial axis, 56·9; P^4, 3·7; M^{s1-3}, 12·0.

ISOODON MACROURUS TOROSUS (Ramsay).

Nine specimens taken in winter from a limited area in the lower Fitzroy Valley, where it is the common bandicoot of the grassy river flats and open timbered country.

From *macrourus* of the Arnhem Land littoral, it differs in the much coarser and more contrasted grizzling of the dorsal hair, but the tawny wash on throat and chest on which Ramsay relied for distinction is not a marked feature in any of the present series. Some males attain to a very large size, but both external and skull dimensions of fully adult specimens are subject to remarkably wide variation. The largest male skull, with a total length of 91 mm., shows considerably less molar wear and wider sutures than the smallest male with a total length of only 83·5 mm. There can be no question of two co-existing races, however, since the whole series is very constant in all characters save that of adult size. Similar differences are recorded by Thomas (B.M. Catalogue, 1888), a skull in the Genoa Museum (not localized by Thomas) having a basal length of 81 mm. as against 75 mm. for the type from Port Essington.

Neither the skull nor body dimensions of the type of *macrourus* are notably different from those of the smaller adult members of the present series, and measurement of larger numbers from the north coast might well disclose similar variation there. In structural features, skulls from the two districts agree closely, though the bullae in *typicus* seem to be somewhat larger than in *torosus*. For the short time that it is completely unworn, the posterior lobe of the upper M^4 in *torosus* is distinctly bicuspidate. Whether this is the origin of Thomas's cryptic remark on the "extra crook on its M^4"[17] I cannot determine, and no skulls of the typical form showing the tooth at the required stage are available for comparison.

The following figures give the range in dimensions of (1) four males, (2) two females, all fully adult and showing distinct facets of wear on the molars:—Head and body, 395-460; 310-410; tail, 170-215, 140-160; pes, 70-73, 60-63; ear, 36, 36.

Range in skull dimensions of (1) five males, (2) one female, all fully adult:—Greatest length (83·5-91·0), (75·3); basal length (75·0-80·4), (67·9); zygomatic breadth (36·1-40·0), (32·1); nasals, length (31·7-35·0), (31·0); nasals, greatest breadth (5·5-7·2), (4·8); intertemporal (11·1-13·0), (11·9); palate, length (49·0-54·1), (46·0); palate, breadth inside M^2 at anterior angle (13·3-16·2), (13·0); anterior palatal foramina (6·5-7·8), (6·8); basi-cranial axis (21·8-23·6), (19·6); basi-facial axis (55·1-57·2), (49·0); P^4 (3·3-3·8), (3·3); M^{s1-3} (12·5-13·9), (13·4).

Isoodon obesulus has been recorded from further north but was not taken here, and *Thalacomys lagotis* is also apparently absent, though it occurs at Epping in the Clermont district, 150 miles W.-N.-N. of the junction of the rivers.

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[17] Ann. Mag. Nat. Hist., ser. 9, vol. ix. (1922), p. 679.

MONOTREMATA.

Ornithorhynchus anatinus (Blumenbach).

Still occasionally seen in the main channel of the Dawson and in some of its tributaries, but evidently now rare. No specimen examined.

Echidna aculeata (Shaw).

Widely spread but not plentiful. A single specimen obtained on the Fitzroy; now mislaid.

MONODELPHIA.

A small collection of Chiroptera was made, including the following forms:—

Pteropus scapulatus (Peters).

An enormous camp of this fruit bat was established in a mixed brigalow and softwood scrub on Coomooboolaroo in 1929. Many specimens.

Pteropus poliocephalus (Temminck).

One specimen from near Rockhampton.

Pteropus gouldi (Peters).

Two specimens from near Rockhampton.

Nyctimene tryoni (Longman).

One ♂ from Serpentine Creek.

Of *Microchiroptera* the following species were taken at various points along the Fitzroy: — *Taphozous georgianus** (Thomas), *Taphozous flaviventris* (Peters), *Eptesicus pumilus** (Gray), *Rhinolophus megaphyllus** (Gray), *Miniopterus schreibersii** (Natterer).

Of these, two specimens of *T. georgianus*, taken in mid-winter of 1932, were remarkable for the development of an enormous inguinal fat deposit.

Canis familiaris dingo (Blumenbach).

Widely spread and in the rougher parts of the country still fairly plentiful. If not persecuted, it persists in such places in the immediate vicinity of large settlements, as for example in the Berserker Hills outside Rockhampton and in the brigalow scrubs fringing the cotton settlements on the Callide Valley. In the more open cattle country it is, of course, severely discouraged by stockmen, but even so it maintains a hold on some of the oldest occupied runs in the valley. It was observed in daylight on several occasions, but no specimen taken.

Vulpes vulpes (Linnaeus) var.

The fox is a very recent intruder into the Dawson and Fitzroy country, but is now established over a large area, and though still a comparatively rare animal, is steadily gaining ground. I have no information as to the date of its first appearance on the Upper Dawson, but in the northern part of the area the first definite record is due to Mr. H. Barnard who saw it in 1917 on Rio Station, 10 miles south of the junction of the two rivers. In 1924 Mr. R. Vallis shot one on Mount Hedlow, 20 miles N.E. of Rockhampton, and since then it has been frequently taken along the Fitzroy.

Felis cattus (Linnaeus).

Numerous; particularly in scrubs and heavy timber. Judging by the refuse of its lairs, it has become almost entirely avivorous.

(*) Part of the bat collection was examined by Mr. E. le G. Troughton, who has very kindly supplied the names marked with asterisks.

Oryctolagus cuniculus (Linnaeus).

There appear to be no reliable records of the presence of the rabbit in the area, but the hare, *Lepus europeaus* var., has been taken in the Taroom district on the Upper Dawson.

Hydromys chrysogaster (Geoffroy).

Well established on nearly all the rivers, creeks and the more permanent billabongs and waterholes, but seem to be rather less plentiful than in similar stations further south.

Three specimens. ♂ and ♀ from the lagoon at Coomooboolaroo, and ♂ from a (usually) dry brigalow scrub at North Rockhampton after the flood of February, 1929.

The three skins (mid-summer) show considerable differences in colouration, but can be very closely matched by summer skins of the species from the Murray in South Australia and from the lower South-Eastern district of this State, but in view of the wide range of individual and seasonable variation which can be demonstrated in water rats from quite restricted areas, and the poor definition of the so-called races which have been named, I have not ventured, in the absence of material from North Queensland, to apply a subspecific name to the Dawson Valley representative.

The largest male from North Rockhampton has the following flesh dimensions:—Head and body, 360; tail, 265; white of tail, 145; pes, 68; ear, 20 × 11.

Skull of another male of approximately the same size:—Greatest length, 62·3; greatest breadth, 30·5; upper molar, low, 9·6.

The indigenous *Murinae* seem to be poorly represented, and with the exception of a single specimen of an apparently undescribed form, which will be dealt with elsewhere, no representatives of this group were obtained.

Mus musculus (Linnaeus) and *Rattus rattus alexandrinus* (Geoffroy) are common and widespread; the latter particularly so in the prickly pear belts, where it flourishes on the fruit, and nests in the forks of the "branches."

Acknowledgments.

It is a pleasure to express my gratitude to Mr. R. Vallis, of Rockhampton, whose frequent contributions of material and data have enabled me to clear many points which would otherwise have remained obscure. The intimate knowledge which both he and his brother, Mr. C. Vallis, have of the northern part of the area treated, was freely placed at my disposal and greatly simplified my work while in the field.

For hospitality and assistance of various kinds I am also much indebted to:—Mr. Charles Barnard, of Coomooboolaroo; Mr. Harry Barnard, of Brisbane; Mr. Stewart Barrett, of Drumburle; Mr. N. H. Robertson, of Thangool; Mr. A. Gherky, of Thangool; Mr. G. Hamilton, of Dawson Vale; Mr. T. Rigby, of Cracow; Mr. G. Rigby, of Glebe; and, finally, to Mr. H. A. Longman, Director of the Queensland Museum, Brisbane.

NOTE ON THE SWARMING AND METAMORPHOSIS OF A CENTRAL AUSTRALIAN CICADA, THOPA COLORATA (DISTANT).

BY H. H. FINLAYSON

Summary

In December, 1933, after a series of rains totalling 3 inches or more, which fell over the greater part of the Musgrave Range in the far north-west of South Australia, the adult of this species *(Thopa colorata)* appeared in prodigious numbers on the Ferdinand and some other creeks of the range.

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[Read October 11, 1934.]

In December, 1933, after a series of rains totalling 3 inches or more, which fell over the greater part of the Musgrave Range in the far north-west of South Australia, the adult of this species *(Thopa colorata)* appeared in prodigious numbers on the Ferdinand and some other creeks of the range.

Such an occurrence had not been noted before by white men who have been in that part of the country for 15 years, and though the insect is well known to the elders amongst the local blacks, men of twenty years or more were seeing the transformation of the larva into the winged form for the first time. Though I was not in a position to make extended observation or enquiry into the matter, the occurrence and its concomitants were of so spectacular a kind that many of its details were forced upon one's attention and, at the suggestion of Mr. H. Womersley who kindly identified the species, I am recording the happening together with some notes made at the time.

The observations were made at Ernabella, on the Ferdinand, in lat. 26° 17′ south and longt. 132° 10′ east, between December 30, 1933, and January 1, 1934. The transformation was taking place only along the banks of the creek, which is here lined fairly profusely with red gums *(E. rostrata)* of moderate growth. The creek had run about a fortnight before my arrival at the place, and as the cicadas had already been in evidence some days it seems likely that the circumstances are not unconnected and that an increase in the moisture content of the soil of the banks may provide the stimulus which induces the larvae to forsake their burrows, some at least of which are several feet deep.

On the morning of December 31 (a day of intense heat) the larvae were emerging in thousands from the soil and were ascending the trunks of the gums, many of which were already thickly studded with empty larval cases. Nearly all transformations which were actually seen took place on gum trunks, but evidently some days earlier in the swarming, the choice of sites had been more catholic, and much of the smaller vegetation, especially buck bush *(Salsola kali)*, here about 18 inches high, was literally smothered with cases.

The chief features of the metamorphosis seem to agree well with what has been recorded for the eastern species *Abricta curvicosta* (Germ.) and *Macrotristra angularis* (Sabr.). On emerging from the holes the larvae crawl rather aimlessly about until they encounter a tree butt by accident as it were, when they ascend to heights of from 4 to 7 feet, always working round to the shady side. The first split in the case took place on an average about 15 minutes after the larva became stationary. The intervals separating the subsequent phases of the process appear to vary considerably in different examples, and perhaps also at different times and temperatures, but the following chronological record of a single instance may be quoted.

11.50 p.m. larva stationary; 12.3, case split; 12.8, head free; 12.14, two-thirds length of cicada projecting at right angles from the case; 12.23, cicada suddenly free and superimposed on case.

In the next few minutes the pale greenish-grey creature, which is very conspicuous on the dark case, moves away with extreme deliberation to a distance of

a few inches, where it becomes perfectly quiescent except that the wings slowly unfurl—a process which occupies from 3 to 13 minutes. The black band connecting the eyes, the crescentic markings of the thorax, and the dark areas on the belly, which are undifferentiated on emergence, now slowly appear. They are distinctly visible at 25 minutes, dark brown at 40 minutes, and jet black at 60 minutes. During this period of maturation and hardening considerable loss of bulk seems to take place, and several examples were seen to expel jets of fluid at intervals, from the anus. The time of first flight was not observed, but is evidently considerably over an hour after emergence.

The numerous predators which have been noted as causing heavy mortality to cicadas do not seem to function here on any large scale. Indeed, the immunity of the soft, newly-emerged cicada from the attacks of ants was a conspicuous and interesting feature in their early history. The gum trunks were swarming with ants of at least three species—some roaming free, some travelling in file on definite routes, but in no case did I see a cicada or larva attacked, though ants were frequently within a few mm. of them. There is, however, nothing actually repellent to ants in the tissues of the cicada. A few instances were noted in which newly-emerged insects had been accidentally dislodged and had fallen, struggling, into the hot sandy soil at the foot of the tree. Here they were at once attacked by swarms of a small black *Campanotus* (?), which was quite indifferent to the stationary cicadas on the trunks.

The song of the fully-developed males, from the tree tops, seemed to be almost continuous throughout the twenty-four hours—it certainly does not stop at nightfall—but its volume fluctuated somewhat, reaching a maximum apparently in the hottest hours of midday. The noise was then overpowering, and its shrill, short-pulsing character most fatiguing. The blacks imitate the sound with great fidelity, and their name for the creature—Tcheereeree—is rather suggestive of its song.

The first lull in the uproar came in the early morning of January 1, when for two hours or more there was a strange silence, suddenly replaced by the usual din which rapidly reached its former proportions.

How far up and down the channel the swarming was taking place I was unable to determine, but in moving about the country in the weeks that followed, cicadas were heard (though not in such enormous volume as at Ernabella) at Erliwunyawunya, 40 miles west (January 3); at a camp in the Everard Range, 70 miles south (January 22); and at Oparinna, 100 miles north-west (February 3).

All these places have stands of red gums *(E. rostrata)* by semi-permanent waters, and they had all shared in the December rain, but whether there had been any flow of water near the timber cannot be stated definitely, though I think it probable.

AN ADAMELLITE FROM "THE GRANITES," NORTHERN TERRITORY.

BY A. W. KLEEMAN, B.SC.

Summary

The rocks described in this paper were collected by Dr. Madigan in 1932. I am indebted to him for the specimens and the following note descriptive of the locality.

"The granite which I have handed to Mr. Kleeman to describe became famous owing to the gold boom at 'The Granites7 in 1932, which I was sent up to investigate and had the unhappy duty of condemning. The 'Granites9 locality is situated in the Northern Territory of Australia in approximately Lat. 20' 47' S. and Long. 130° 30' E. It is 373 miles north-west of Alice Springs and 60 miles south-east of Tanami Gold Field. The area was prospected by Allan A. Davidson in 1900. He discovered gold at Tanami and at the Granites) which latter locality he referred to as Granite Hill. Rock outcrops are scarce in the region of the Granites, which is a vast level peneplain at an altitude of about 1,500 feet above sea level. The country is a sea of scrub in which are dotted about, at intervals of something like 50 miles, low islands of rock. The Granite Hill is a mass of boulders and tors with a base some two hundred yards across and rising to a height of something under a hundred feet. It is the most prominent feature within 50 miles in all directions. Half-a-mile to the north-east a schist ridge begins and runs in a long curve northerly) and then westerly) for a total distance of $5^{1}/_{2}$ miles. The granite intrudes the schists and is exposed by mining operations at several points inside the curve. There are some much lower granite knolls close to the eastward, and at 43 miles east there is another low granite dome a hundred yards across, known as 'Thomson's Rockhole. This rock is identical in appearance with that at the Granites. The schists I consider to be of Archaean Age and the Granite to be of Mosquito Creek Age, that is Older Proterozoic."

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There are two specimens from the Granites Hill. One from the north side was chosen for description and analysis as a typical specimen. The specimen from the southern side was a little coarser, but the variation is no more than is usual in a granite outcrop. A specimen from Thomson's Rockhole was also examined.

Petrographic Description of the Type Rock.

Macroscopic Features.

A grey holocrystalline rock. The mass of the specimen is fine-grained, but there are porphyritic individuals of microcline up to a centimetre in length. The minerals recognisable in hand specimens are quartz, felspar and biotite. Much of the felspar is white and opaque, but the larger microcline crystals are clear. The biotite is scattered through the rock in small flakes.

Microscopic Features.

The minerals present are as follows:—

Quartz is clear but frequently shows shadowy extinction. It is not intergrown with the felspar. The larger inclusions are rutile and apatite. Strings of inclusions can be made out to be dust and liquid. Some of the liquid inclusions have small gas bubbles in them.

Microcline is the only potash felspar in the rock. It is for the most part unaltered. The larger crystals are up to 5 mm. across and have inclusions of all the other minerals. The typical cross-hatching is well developed. Twinning on the Carlsbad Law is much less common.

Plagioclase is the dominant felspar. It has altered throughout the rock to albite and zoisite. The albite retains the crystal form and structure of the original plagioclase, but is rendered almost opaque by the minute zoisite crystals. This alteration makes the precise determination of the plagioclase difficult. The Refractive Index is above that of Canada Balsam. The maximum extinction in the zone perpendicular to 010 is about 4°, which corresponds to a composition $Ab._{75}$ $An._{25}$. This is only an approximation. The alteration products are indeterminate, but some few crystals larger than the rest appear to be zoisite. There does not appear to be any calcite present. This alteration seems to be due to age and some slight metamorphism.

Biotite is scattered through the rock in small flakes. It exhibits intense pleochroism, changing from light greenish-yellow to a very dark brown. Basal sections ·03 mm. in thickness are opaque. A few pleochroic haloes are observed around small zircon crystals. There is some alteration to chlorite.

Sphene forms a few subhedral crystals. It is of a brown colour with slight but noticeable pleochroism.

Apatite is not common, but is present as small rods included in the other minerals.

Zircon is seen as the core of pleochroic haloes in biotite.

Epidote is formed as an alteration product of plagioclase. It is slightly yellow and has high polarisation colours. Some crystals appear to be closer to zoisite, while the smaller crystals in the plagioclase are zoisite.

The order of crystallisation is:—(1) Biotite and Sphene, (2) Plagioclase, (3) Quartz, (4) Microcline. The large size of the microcline crystals does not seem to be due to early crystallisation, as it includes all other minerals giving a semblance of Poecilitic structure. The texture is slightly porphyritic, the groundmass allotromorphic granular. The grain size of the quartz and plagioclase lies between 0·3 mm. and 1·2 mm., the quartz tending towards the lower limit and the plagioclase towards the upper limit. The microcline ranges from about 1·0 mm. to 5 mm., the most lying between 1·0 and 2·0 mm.

The mode was obtained by the Rosiwal Method:—

Quartz	34·4%	Biotite	6·5%
Microcline	26·0%	Sphene	0·5%
Plagioclase	32·6%		

The slide examined appeared to be too rich in quartz to be quite typical.

The specific gravity is 2·688.

The analysis of this rock was made by the writer and is as follows:—

SiO_2 (Silica)	71·55	H_2O- (Water at 105°)	0·05
TiO_2 (Titania)	0·39	H_2O+ (Water above 105°)	0·43
Al_2O_3 (Alumina)	15·00	P_2O_5 (Phosphoric Anhydride)	0·19
Fe_2O_3 (Ferric Oxide)	·56	BaO (Baryta)	Nil
FeO (Ferrous Oxide)	2·13	ZrO (Zirconia)	0·04
MnO (Manganous Oxide)	0·04	Cr_2O_3 (Chromium Oxide)	Nil
MgO (Magnesia)	0·14	S (Sulphur)	0·06
CaO (Lime)	2·18		
Na_2O (Soda)	3·92	Total	100·36
K_2O (Potash)	3·68		

The Norm is as follows:—

Quartz - -	29·16	Q	29·16	Salic Group -	94·58
Orthoclase - -	21·13				
Albite - -	33·54				
Anorthite - -	9·73	F	64·40		
Corundum - -	1·02	C	1·02		
Hypersthene (Fs) -	2·77			Femic Group -	5·41
(En) -	0·40	P	3·17		
Ilmenite - -	0·76				
Magnetite - -	0·93	M	1·69		
Apatite - -	0·44				
Pyrites - -	0·11	A	0·55		
Water - -	0·48				

The C.I.P.W. classification of the rock is I. 4. 2. (3)4.

The Magmatic name is *Toncanose-Lassenose.*

The rock is an *Adamellite.*

According to Prof. Johannsen's proposed classification it is in group 2.2.7″.

The rock from the south side is of a slightly coarser grain size, but is so essentially similar in structure and mineral composition as to render description unnecessary. The specimen from Thomson's Rockhole, though distant 43 miles from the outcrop at the Granites is again similar to the type, and there can be no doubt that the two occurrences represent but two exposures of a granite type which occurs persistently through the area.

THE MURRAY BRIDGE GRANITE.

BY A. W. KLEEMAN, B.SC.

Summary

The Murray Bridge granite is seen in a number of exposures in and around Murray Bridge. The existing outcrops are exposed as a result of the River Murray cutting down into the Tertiary limestone and exposing the Old Pre-Tertiary land surface. The real extent is probably much greater than the outcrops suggest, and it is not unreasonable to suppose that the pegmatites and other igneous rocks at Rocky Gully (3 miles west of Murray Bridge) are but a phase of the same stage of intrusion. The granite may be seen in many places along the river flats near Murray Bridge. There is a very conspicuous tor near the Sturt Reserve and several less noticeable outcrops between this place and the town itself. The piers of the new-Railway Bridge are all based upon a bar of granite below the muds of the river bottom. The type locality is at Swanport, about 2 miles south of Murray Bridge, where there are several outcrops. The largest outcrop has been quarried for building stones and is described in Dr. Lockhart Jack's report on "The Building Stones of South Australia"[1] as a "whaleback about 10 chains long and 2 chains wide and projecting about 25 feet above the alluvium of the Murray Flats." The stone is quarried at the eastern end of the outcrop. Here the Tertiary limestone may be seen resting upon the granite, which is weathered to a depth of about 2 inches. Stone from this quarry has been used extensively in South Australia.

THE MURRAY BRIDGE GRANITE.

By A. W. Kleeman, B.Sc.

[Read October 11, 1934.]

The Murray Bridge granite is seen in a number of exposures in and around Murray Bridge. The existing outcrops are exposed as a result of the River Murray cutting down into the Tertiary limestone and exposing the Old Pre-Tertiary land surface. The real extent is probably much greater than the outcrops suggest, and it is not unreasonable to suppose that the pegmatites and other igneous rocks at Rocky Gully (3 miles west of Murray Bridge) are but a phase of the same stage of intrusion. The granite may be seen in many places along the river flats near Murray Bridge. There is a very conspicuous tor near the Sturt Reserve and several less noticeable outcrops between this place and the town itself. The piers of the new Railway Bridge are all based upon a bar of granite below the muds of the river bottom. The type locality is at Swanport, about 2 miles south of Murray Bridge, where there are several outcrops. The largest outcrop has been quarried for building stones and is described in Dr. Lockhart Jack's report on "The Building Stones of South Australia"(1) as a "whaleback about 10 chains long and 2 chains wide and projecting about 25 feet above the alluvium of the Murray Flats." The stone is quarried at the eastern end of the outcrop. Here the Tertiary limestone may be seen resting upon the granite, which is weathered to a depth of about 2 inches. Stone from this quarry has been used extensively in South Australia.

The granite is very uniform over the area in which it is exposed, the only variation being a vein of aplite 4 feet wide and running in a direction N 27° E. at the western end of the Swanport outcrop, and several smaller veins only a few inches thick in the other outcrops.

Petrographic descriptions are given of both the granite and the aplite.

Petrographic Description of the Granite.

Macroscopic Features.

A coarse-grained holocrystalline rock of red colour. The minerals which can be seen in hand specimen are quartz, microcline, plagioclase, biotite, and magnetite. The quartz is in smoky grains with a vitreous lustre. The microcline (Microperthite) forms large reddish crystals which may attain a size of 2 to 3 centimetres. The plagioclase is white and rather clear. It occurs both as small crystals, 1 to 5 mm., and as zones around some of the orthoclase crystals.

The polished surface of the rock shows the relations, the large orthoclases set in in a matrix of granular quartz and plagioclase. The biotite forms smaller flakes in the quartz aggregates.

Microscopic Features.

The structure is controlled by the large perthitic microcline crystals. They appeared to have commenced crystallization at an early stage and to have attained porphyritic development before the plagioclase finished crystallizing, as many of the microcline crystals have a complete outer zone of plagioclase. On the other hand crystals which have plagioclase zones may include grains of quartz and

(1) R. Lockhart Jack, Geol. Surv. South Austr., Bull. 10, 1923, p. 70.

plagioclase. Such plagioclase as is not zoned around the microcline is associated with groups of microcline crystals. The quartz, with the biotite associated, makes up a granular matrix in which the average size of the grains is about 1 mm.

The minerals present are:—

Quartz is very abundant as clear colourless crystals. Inclusions are relatively abundant and appear to be orientated in two directions, giving the so-called rift and grain effect. Many of these inclusions, when resolved under high magnifications, can be seen to be fluid and to contain gas bubbles.

The Potash Felspar is represented by *Microcline Microperthite*. It does not show the typical grating effect of Microcline, but can be distinguished from orthoclase by the extinction which in section perpendicular to Z is 10° ($X' \wedge 001$). The grating effect can be seen in some exceptional crystals, and then only poorly developed. The intergrown plagioclase is not twinned, but it is probable that it is more sodic than the plagioclase of the rock. The albite lamellae are rather more weathered than the microcline.

The *Plagioclase* is clear and unweathered. It is twinned on Carlsbad, Albite, and Pericline laws. The individuals in the Pericline and Albite twins are thin. The maximum extinction on zone perpendicular to 010 is — 2°, which corresponds to $Ab._{77}$ $An._{23}$. The plagioclase mantling the microcline has the same composition, but that separating from the perthite is more sodic.

Biotite is a dark highly pleochroic variety. The pleochroism is X = light golden brown Y = Z = dark brown to opaque. Basal sections in a slide ·03 mm. thick are opaque with normal bright illumination. It is biaxial negative with a very small optic axial angle. Its properties are that of a biotite rich in iron, lepidomelane. This is borne out by the small amount of magnesia in the analysis.

Sphene is very light brown with slight pleochroism. Occurs in several large grains in the slide.

Fluorspar is usually associated with the biotite as irregular crystals with high negative relief. The presence of this mineral is a notable feature not previously recorded.

Apatite is not abundant, but some few well-shaped crystals are associated with the biotite and magnetite.

Magnetite forms a few relatively large grains.

Zircon occurs in small quantity.

The specific gravity of the rock is 2·639.

The analysis of the granite quoted below was carried out by Mr. W. S. Chapman, of the Assay Department, and is quoted in Dr. Jack's Bulletin *(op. cit.)*. The author has determined fluorine, which was not included in the original analysis:—

SiO_2 (Silica) - - -	74·20	CO_2 (Carbon Dioxide) - -	0·11
TiO_2 (Titania) - - -	0·29	P_2O_5 (Phosphoric Anhydride) -	0·08
Al_2O_3 (Alumina) - -	14·53	FeS_2 (Ferric Disulphide) -	0·10
Fe_2O_3 (Ferric Oxide) - -	1·14	BaO (Baryta) - - -	Nil
FeO (Ferrous Oxide) - -	0·90	Cl (Chlorine) - - -	0·03
MnO (Manganous Oxide) -	0·03	F (Fluorine) - - -	0·19
MgO (Magnesia) - -	0·20		
CaO (Lime) - - -	1·00		99·71
Na_2O (Soda) - - -	3·06	Less O for F and Cl - -	·09
K_2O (Potash) - - -	3·55		
H_2O- (water at 105°C.) - -	0·15		99·62
H_2O+ (water above 105°C.) -	0·15		

The norm is as follows:—

Quartz - -	41·40	Q = 41·40	Salic Group = 95·40
Orthoclase - -	21·13		
Albite - - -	25·68		
Anorthite - -	2·50	F = 49·31	
Corundum - -	4·69	C = 4·69	
Hypersthene - -	0·76	P = 0·76	Femic Group = 3·87
Ilmenite - -	0·61		
Magnetite - -	1·62	M = 2·23	
Apatite - -	0·20		
Fluorite - -	0·43		
Calcite - -	0·25		
Pyrite - - -	0·10	A = 0·88	
Water - - -	0·30		

In the C.I.P.W. classification the rock is, therefore, I. 3. 1 (2). 3′. The magmatic name is *Tehamose Alaskose.*

The mode was obtained by measuring the minerals on a polished slab. Eight lines a centimetre apart and 46 centimetres long were set out and the intercept of each mineral measured. The result is as follows:—

Quartz - - -	33·8%	Biotite - - -	3·3%
Microcline Microperthite	46·0%	Magnetite - -	0·3%
Plagioclase -	16·6%		

A comparison with the norm shows that the microperthite must contain a notable percentage of the soda of the rock. The rock is a *Granite.*

According to the classification of Professor Johannsen[2] it would be called a *Leuco-Granite* 1.2.6″ P.

Petrographic Description of the Aplite.

Macroscopic Features.

The rock has a fine even-grained texture and a light pinkish-brown colour. The minerals distinguishable in hand specimen are quartz, felspar, and biotite. The quartz has a tendency toward the formation of occasional larger crystals, which have the smoky appearance seen in the quartz of the granite. The felspar is light pink in colour. Biotite is not common and collects in small aggregates.

Microscopic Features.

A fine-grained holocrystalline rock. The texture is allotriomorphic granular. The porphyritic quartz crystals can be seen with a diameter up to 3·0 mm. The grain size of the rock is by no means uniform, but the average appears to lie between 0·3 and 0·5 mm.

The minerals present are:—

Quartz is very abundant as clear colourless grains. The few inclusions occur in strings without any obvious orientation. The inclusions can be seen to be fluid, some of which contain gas bubbles. Some of the larger crystals show undulose extinction, but the majority do not.

Microcline.—Shows the usual characteristic cross-hatching. It is for the most part rather more altered than the plagioclase. It encloses grains of quartz, plagioclase, and biotite.

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(2) Johannsen, "Petrography," vol. ii., Chicago, 1932.

Plagioclase is present in approximately equal quantity with the microcline. The maximum extinction angle in zone perpendicular to 010 is 15°, which corresponds to a composition $Ab.^{95}$ $An.^{5}$. It is clear and undecomposed. There is very little intergrowth with microcline, a few plagioclase grains being included in microcline.

Biotite is strongly pleochroic, similar to that in the granite. Pleochroic haloes are not common. The biotite is altered to a slight extent to chlorite.

Fluorite is present with its characteristic high negative relief and isotropic crystals.

Magnetite is rare and is changing to haematite.

Apatite, several small crystals.

Zircon occurs in biotite sparingly, and there are one or two crystals scattered through the slide.

An analysis of this rock was carried out by the author with the following results:—

SiO_2 (Silica)	76·07	P_2O_5 (Phosphoric Anhydride)	0·01
TiO_2 (Titania)	0·11	BaO (Baryta)	Nil
Al_2O_3 (Alumina)	13·96	Cr_2O_3 (Chromic Oxide)	Nil
Fe_2O_3 (Ferric Oxide)	0·14	ZrO_2 (Zirconia)	Trace
FeO (Ferrous Oxide)	0·42	FeS_2 (Ferric Disulphide)	0·13
MnO (Manganous Oxide)	Trace	F (Fluorine)	0·10
MgO (Magnesia)	Str. trace		
CaO (Lime)	0·68		100·41
Na_2O (Soda)	3·90	Less O. for F	0·04
K_2O (Potash)	4·64		
H_2O- (Water at 105°)	0·07		100·37
H_2O+ (Water above 105°)	0·18		

The norm is as follows:—

Quartz	34·26	Q = 34·26	Salic Group = 98·82
Orthoclase	27·24		
Albite	33·01		
Anorthite	2·78	F = 63·03	
Corundum	1·53	C = 1·53	
Hypersthene (Fs)	0·53	P = 0·53	Femic Group = 1·24
Ilmenite	0·15		
Magnetite	0·23	M = 0·38	
Fluorite	0·20		
Pyrite	0·13	A = 0·33	
Water	0·25		

In the C.I.P.W. classification the rock is I. (3)4. 1′. 3′.

The magmatic name is *Alaskose-Liparose.*

The mode was determined by the Rosiwal Method:—

Quartz	33·8%	Biotite	1·2%
Microcline	34·3%	Fluorspar	0·4%
Plagioclase	30·3%		

The Specific Gravity of the rock is 2·627.

The rock is *Granite Aplite.*

According to Johannsen's proposed classification the rock is an *Alaskite Aplite* 1.1.6″ D.

Conclusions.

The analyses of these rocks bear many points of similarity which show them to belong to the same suite. Both have little or no magnesia, a fact which is borne out by the intense pleochroism of the biotite. The aplite is very rich in silica. The quartz forms a few large smoky crystals which much resemble the quartz of the granite. These smoky crystals may have been derived from the granite by some differentiation and have been present as such in the aplite when it was intruded. Fluorine is common to both rocks, and so far has not been detected in any other South Australian granites. A noteworthy feature of the granite is the difference in composition between the calculated plagioclase (Ab 90) and the actual plagioclase Ab 80. This is due to the fact that the plagioclase of the microperthite is much less calcic than the plagioclase which has crystallized out. This appears to be connected with the zoning of the plagioclase around the perthite. There is no evidence to show why this zoning should occur.

Some attempt was made to connect these rocks with those described from Mannum area by A. R. Alderman,[(3)] but with little success. It is worthy of note, however, that the Aplite, when plotted on Alderman's graph, lies on the continuation of differentiation of the Tonalite-Aplite Series towards decreasing ferromagnesian constituents.

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(3) A. R. Alderman, "Magmatic Differentiation of Mannum," Proc. Roy. Soc., S. Austr.

ABSTRACT OF THE PROCEEDINGS

Summary

ABSTRACT OF THE PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA (Incorporated).

FOR THE YEAR FROM NOVEMBER 1, 1933, TO OCTOBER 31, 1934.

ORDINARY MEETING, NOVEMBER 9, 1933.

The President (Mr. J. M. Black) in the chair, and 30 members were present.

Minutes of the Annual Meeting, held October 12, 1933, were read and confirmed.

On declaring the meeting open, Mr. Black thanked the Fellows for the honour they had conferred upon him by electing him as President, and briefly referred to the important and valuable work that had been performed by the ten Presidents who had occupied the chair since the retirement of Sir Joseph Verco, after many years' service. Mr. Black then drew attention to the changes which had recently taken place on the honorary executive staff of the Society. He thanked Professor J. A. Prescott (the Immediate Past President), who was a model of ability and efficiency, for the services he had rendered during his term of office, Dr. Chas. Fenner, who had retired from the office of Treasurer, and Professor Walter Howchin, who, after more than 40 years' service, had just retired from the office of Editor. Mr. W. H. Selway then moved that the Society place on record the very valuable work that had been performed by Professor Howchin during his term as Editor. Mr. C. T. Madigan, in seconding the motion, made special reference to the sterling qualities of the Professor, and said that his regular attendance and prominent and familiar figure will be very much missed by the Fellows, and intimated that he would not, in all probability, be seen again at any of the evening meetings of the Society. The motion was supported by Professor J. Burton Cleland, and carried.

The President then called for nominations for the office of Editor, due to the retirement of Professor Howchin. Dr. L. Keith Ward nominated Dr. Chas. Fenner. The nomination was seconded by Professor J. Burton Cleland. There being no further nominations, the President declared Dr. Fenner duly elected.

Sir Douglas Mawson enquired if it was the intention of the Society to continue the practice of publishing the name of the Editor in prominent type on the title page of the Transactions and Proceedings. The President, in reply, informed Sir Douglas Mawson that the question raised would be brought under the notice of the Council.

NOMINATIONS AS FELLOWS.—Eustace Couper Black, M.B., B.S., Medical Practitioner, Magill Road, Maylands; Claude Lancelot McCloughry, B.A., A.M.I.E. (Aust.), Consulting Engineer, 271 Melbourne Street, North Adelaide.

ELECTION OF FELLOWS.—Miss Constance Margaret Eardley, B.Sc.; Miss Violet Taylor. A ballot was taken, which resulted in their election.

PAPERS—

"The Arltunga and Karoonda Meteorites," by Sir Douglas Mawson, D.Sc., B.E., F.R.S. The author gave a brief resumé of the occurrence of the fall of meteorites in different parts of the world, and then described the essential features

in connection with the meteorites described in the paper. The subject evoked a keen discussion, in which Professor J. Burton Cleland, Dr. Robt. H. Pulleine, Dr. L. Keith Ward, Dr. Chas. Fenner, and the President took part.

"Notes on Fossiliferous Cambrian near Kulpara," by T. A. Barnes, B.Sc., and A. W. Kleeman.

Exhibits—

Professor J. A. Prescott exhibited two photographs of a geological feature which appears on the Queensland Geological Map as the Great Basalt Wall. This has never been described by a geologist, although it must be one of the finest geological features in Australia. The wall is from 60 to 70 miles long, and up to 7 miles in width, the average being about 2 miles, and is from 100 to 200 feet high, and commences about 40 miles north of Charters Towers. A remarkable natural feature is that no soil occurs on the outcrop, which consists of vesicular lava, with deep cracks and caverns. Trees adjacent consist of inland scrub type.

Sir Douglas Mawson exhibited some specimens of fossil mollusca in a quartzite which has a range of about 50 feet, and is of Cambrian age, obtained along the coast south of Moana.

The President extended a welcome to Dr. and Mrs. Walkley as new members.

Ordinary Meeting, April 12, 1934.

The President (Mr. J. M. Black) in the chair, and 41 members were present.

Minutes of the Ordinary Meeting, held November 9, 1933, were read and confirmed.

An apology was received from Mr. J. H. Gosse.

The President said that it was his pleasant duty to present, on behalf of the Society, the Sir Joseph Verco Medal to Professor John Burton Cleland. Addressing the Fellows he said:—"This is the fourth occasion on which the medal has been awarded, and I think you will all agree with me that it is a fitting tribute to a great scientific career. The Professor's scientific activity is so many-sided that it is almost impossible for any one man to speak informatively upon it. Doubtless enthusiasm, which he knows how to communicate to others, and a great power of concentration upon any subject which he may take in hand, always characterises his work. Of that work I am unable to give any detailed account because much of it is entirely beyond my scope. As you all know, he has been Professor of Pathology at the Adelaide University for the past 14 years. The orbit of his activities, and of his enthusiastic activities, is a much wider one. When I became your President a few months ago, I found that I was automatically promoted to a position on the Board of Governors of the National Park. I met Professor Cleland there, and learned that he was not only a permanent member of that Board, but one of its most prominent, active, and best-informed members. The impression I have gathered is that wherever initiative is required, you can look confidently to Professor Cleland to supply that desideratum. If it were permissible to descend to slang before a gathering of the Royal Society, I would say that he is a "live wire." As regards his scientific work, I shall only refer to the section of which I have some knowledge—Botany. In the branch of that science known as Maeology Professor Cleland is, I believe, the principal authority on the larger fungi—the mushrooms, and he has described a great number of new species in our Transactions. He is also a keen investigator of our flowering plants, and as a collector of specimens, both in the settled districts, and far beyond, he is pre-eminent. You have heard one of our former Presidents, Professor T. Harvey Johnston, describe in a humorous way how, on Far Northern expeditions, the motor car became so filled with Professor Cleland's ever-

increasing collections that there remained scarcely any room for the human cargo. Of these hundreds, if not thousands, of specimens I can speak personally, for nearly all of them have passed through my hands, and I have been pleasantly impressed by the care with which they have been collected and dried. As to the local florulas of such districts as Kangaroo Island, Encounter Bay, the coastal country near Adelaide, notes as to the economic use of plants by the natives of the Far North, and of Central Australia, are not these contributions from his pen printed in the Transactions of our Society for all to read? The Professor has been a Fellow of this Society for nearly 40 years, and in 1928 he held the office of President. It was not the first time that he filled such a position, for in 1917 he was elected President of the Royal Society of N.S.W., at a time when he was the principal micro-biologist to the Department of Health in Sydney. Professor Cleland is a South Australian by birth. His father, the late Dr. William Lennox Cleland, was for many years a Fellow of this Society, and filled the office of President from 1896 to 1899. These are merely a few words to accompany the presentation of the medal. They give a very faint and inadequate idea of the work which Professor Cleland has done, and is still doing, in many branches of science. I must not trespass further on your time, but I should just like to say in conclusion, that I believe it was chiefly due to his energy and powers that the Government was induced to undertake the publication of the series of scientific handbooks dealing with our State." Mr. Black then addressed Professor Cleland, and said that it gave him the greatest pleasure in presenting to him, on behalf of the Royal Society, the Sir Joseph Verco Medal, the highest honour which is in its power to bestow.

Professor Cleland, in response, thanked the President for his kind remarks, and expressed his appreciation of the high honour conferred upon him, and said that he was gratified to receive the medal for two reasons:—First, because it was founded in honour of a very distinguished medical man—Sir Joseph Verco, who was the father of the Medical School in this State, and who played a prominent part in the University of Adelaide, and in this Society. The second reason was that he had received the medal from the hands of Mr. Black, who was a recipient of the medal himself.

The President then said:—"I should be failing in my duty if I did not again rise to tender our hearty congratulations to Professor Walter Howchin—the doyen of our Society—on the award recently made to him of the Lyell Medal by the Geological Society of London. This is no new experience for Professor Howchin, who is now, I believe, the holder of five or six medals awarded in acknowledgment of his scientific researches. I think I am correct in saying that the Lyell Medal is the highest honour which can be conferred for geological research, and it constitutes another proof that Professor Howchin enjoys not only in Australia, but a world-wide reputation in connection with that science to which he has devoted his life with such whole-souled enthusiasm.

Dr. L. Keith Ward then gave a brief resumé of Professor Howchin's distinguished scientific researches, and his valuable services as an Officer of this Society, and then moved:—"That Professor Howchin be elected an Honorary Fellow of this Society." The motion was seconded by Mr. N. B. Tindale, and carried.

The President then said that he should like, with the permission of the audience, to express the pleasure of the Fellows that another very popular and hard-working Fellow had received the degree of Doctor of Science from the University of Oxford. Dr. Madigan had worked as a geologist in many parts of the world, from the burning sands of the Soudan, to the frozen desolation of the Antarctic Continent. This degree, from one of the oldest and most celebrated of Universities, was awarded for his original work in geology, geography,

and meteorology. Dr. Madigan is quite up to date in his methods of research. He has flown over Lake Eyre, and in 1929 he surveyed from the air a waterless desert in the south-eastern part of Central Australia, consisting of many parallel rows of sandhills, which neither native or white man had been able to cross.

Election as Fellows.—E. C. Black, M.B., B.S., Medical Practitioner, Magill Road, Tranmere; E. L. McCloughry, B.E., A.M.I.E. (Aust.), Consulting Engineer, 271 Melbourne Street, North Adelaide; R. C. Shinkfield, Clerk Meteorological Bureau, West Terrace, Adelaide. A ballot was taken and the President declared them duly elected.

Papers—

"The Composition of Some Ironstone Gravels from Australian Soils," by Professor J. A. Prescott, D.Sc., A.I.C., was presented by C. S. Piper, M.Sc.

"Kinship and Descent in Australia," by H. K. Fry, D.S.O., M.B., B.S., B.Sc., D.P.H., Dipl.Anth. A keen discussion followed, in which the following took part:—Mr. A. G. Edquist, Mr. N. B. Tindale, Mr. W. H. Selway, and the President.

"The Impact of the Psychic on the Physical," by Edwin Ashby, F.L.S., M.B.O.U.

The President expressed the sympathy of the Fellows to Mr. Ashby on the serious loss he had sustained by the bush fire which had destroyed his home, and valuable Ornithological collection.

Ordinary Meeting, May 10, 1934.

The President (Mr. J. M. Black) in the chair, and 32 Members were present.

Minutes of the Ordinary Meeting, held April 12, 1934, were read and confirmed.

The President read a letter received by the Secretary from Professor Walter Howchin, in which he gratefully acknowledged the honour conferred upon him by this Society in electing him an Honorary Fellow, and intimating that as a slight token of his appreciation and thanks for the great assistance rendered to him by this Society in the publication of so many of his papers in the Proceedings, that he desired to donate the sum of £40 to the Endowment Fund, this sum being the amount (with exchange) which he had been awarded with the Lyell Medal by the Geological Society of London.

The President then informed the Fellows that Professor Howchin had recently been elected an Honorary Fellow of the Royal Society of N.S.W.

Nomination as Fellow.—John Johnston, A.S.A.S.M., Chemist, Sewage Treatment Works, 32 Fisher Street, Norwood.

Papers—

"Notes on the Aborigines of the South-East of South Australia, Part I.," by T. D. Campbell, D.D.Sc. The following Fellows took part in the discussion of the paper:—Mr. N. B. Tindale, Dr. Chas. Fenner, Dr. L. Keith Ward, and the President.

"On the Australian Species of Japygidae (Thysanura)," by H. Womersley, A.L.S., F.R.E.S.

"Single Value Climatic Factors," by Professor J. A. Prescott, D.Sc., A.I.C., was read by Dr. James Davidson. Dr. L. Keith Ward, Mr. A. G. Edquist, and the President discussed various aspects of the paper.

"The Monthly Precipitation—Evaporation Ratio in Australia as Determined by Saturation Deficit," by James Davidson, D.Sc. In the keen discussion which followed, Mr. A. G. Edquist, Dr. Chas. Fenner, and Dr. L. Keith Ward took part.

Exhibits—

Dr. L. Keith Ward exhibited some doubly-terminated quartz crystals which had been forwarded by Miss Mattner from a locality near Yarcowie. The tendency to form these complete crystals is always present in quartz, but the physical surroundings are seldom favourable for the development of the two complementary rhombohedra which give the pyramidal termination at each end of a crystal.

Dr. T. D. Campbell exhibited samples of oil preparations obtained from one of the tea-tree family *Melaleuca alternifolia*. Beneficial theurapeutic properties are claimed. Also the claw of *Cryptodromia octodentata* which emulated the jaws of an animal in a striking fashion.

Ordinary Meeting, June 14, 1934.

The President (Mr. J. M. Black) in the chair, and 23 members were present.

Apologies were received from Dr. L. Keith Ward and Dr. Chas. Fenner.

Minutes of the Ordinary Meeting, held May 10, 1934, were read and confirmed.

Nomination as Fellow.—Rev. H. A. Gunter, Minister of Religion, 33 Kensington Terrace, Norwood, was read.

Election as Fellow.—John Johnston, A.S.A.S.M., Chemist, Sewage Treatment Works, 32 Fisher Street, Norwood.

The President extended a welcome to Mr. R. C. Shinkfield as a new Fellow of the Society.

Exhibits—

Sir Douglas Mawson exhibited:

(a) Cryptozoön limestone resembling that already recorded from the MacDonnell Ranges and from the North Flinders Range, but obtained from a new locality in the Southern Flinders Range near Eurelia. The new records are of the same vertical columnar form common in the Pre-Cambrian and Cambrian rocks of the other localities mentioned. Its association with coarse oolitic limestone is similar to that found in the late Pre-Cambrian of the North Flinders Range. Its stratigraphical position appears to be that of the Brighton limestone horizon.

(b) A portable collection of some of the leading chemical elements.

Mr. H. H. Finlayson, in exhibiting specimens of Mastacomys fiscus, stated that they formed part of a series taken by him in Cradle Valley, N.-W. Tasmania in 1931, and were the first examples of the animal to be obtained since the British Museum acquired the unique type specimen in 1852. He pointed out some distinctive features in the dentition of the animal, and drew attention to its convergent similarity to some voles of the subfamily Microtinae of the Northern Hemisphere.

Mr. E. H. Ising exhibited a number of specimens of native plants collected at McDonald Station, 150 miles north-east from Alice Springs. The shrub and tree vegetation on the hills, ranges, and flats were fairly plentiful and at times thick and dense. The ground flora is plentiful after the March rains, but at the time of the visit, August and September, 1933, it was rather sparse. In the sandhill country the plant life was very different, having an interesting suite of plants of its own. Among the species shown was the following:—*Grevillea*, sp., a tall shrub with golden flowers; *Erythrina vespertilio*, a bean tree with scarlet seeds; several mallees, including *Eucalyptus gamophylla* and *E. pachyphylla*, and *Newcastlia cephalantha*, a rare verbenaceous plant. These are from the sandhill country. The following grow on the ranges or flats:—*Fiscus platypoda*, a fig growing amongst rocks; *Grevillea* and *Hakea* opp.; *Loranthus gibberulus*, a

mistletoe; *Acacia spondylophylla,* a wattle giving off a scent, like curry; *Vertilago viminatis,* supple jack, a good sheep fodder; *Brununia australis,* the beautiful pin-cushion plant which is also found in our hills; *narodenia australis,* native pear, "Alungwa" of the Illiaura tribe, and the young fruits and leaves are eaten by them.

Dr. W. Christie exhibited a fungus from Halidon similar to those shown by Professor Cleland. One specimen showed fluorescence at the tips when placed under the ultra-violet lamp. He asked members for information concerning the nature of the fungus, and also for information as to his second exhibit. This consisted of a group of hollow structures of varying sizes, and probably of organic origin, which came from Elliston, and whose walls were calcified. They are locally known as "Rabbit eggs," or "Fairy slippers." They are found on Flinders Island, as well as on the coast.

Professor J. Burton Cleland showed portion of a karri sleeper from Halidon, near Alawoona, disintegrated by a fungus which appeared to be a new species of *Lentinus.* This fungus permeates the wood and then transfers the food materials absorbed into large digitate sclerotia, some as big as a child's head, the finger-like processes pointing downwards in the ground. Eventually all the nourishment is transferred from the wood to the sclerotium. A rotting sleeper was dug up and replanted in sand adjacent to the railway line, and it produced a fruiting body from the upper surface of the sclerotium after the first autumn rains. He also showed a very large false sclerotium weighing 17 lbs. 2 ozs., which bore the fruiting body of *Polyporus basilapiloides.* The food materials in the sclerotium had been extracted from a piece of rotten wood.

Dr. T. D. Campbell exhibited three sets of plaster models made from impressions of the dental arches and palates of three young adult male aborigines. They illustrated the very fine jaw development among these people. Models of well-formed modern white jaws were also shown for comparison. Two partly-formed upper incisor crowns from the skull fragments of an Australian Aboriginal infant were exhibited as examples of striking width of incisor tooth crowns.

Professor T. Harvey Johnston exhibited a large angler fish or frog fish *Rhyncherus filamentosus,* caught by Mr. S. How at Port Willunga. The species is characterised by its wide black and white bars or blotches, its smooth skin bearing abundant soft processes, its short stalked eye, and its long "fishing rod" with a bifurcate "lure." Also a minute frog fish taken off the Tasmanian coast, and a quantity of otoliths of the mulloway, taken from an aboriginal midden on a sand dune to the north of Port Willunga. There were also some fragments of human skeleton present.

Mr N. B. Tindale exhibited a series of Hepialid moths, *Oxycanus diremptus* Walk, from Moe, Victoria. Mr. C. G. L. Gooding recently noticed freshly-emerged moths being eaten by frogs, and on request forwarded a series of the predators, which prove to be two species of tree frogs *(Hyla)* and *Limnodynastes dorsalis.* The moths feed upon the roots of the Cootamundra wattle (Acacia Baileyana) and emerge in April, usually during or shortly after rain, and at such times a fair percentage may be destroyed by the frogs.

Mr. H. Womersley exhibited moths and larva of three species of hawk moths *(Sphingidae),* the vine hawk moth *(Deilephila celerio),* always common. The silver-striped hawk moth, fairly common, in the more northern and drier parts of the State, but seldom seen near Adelaide, a young larva taken near Adelaide was shown. Convalienlees hawk moth, which this year has been fairly common around Adelaide, many larva having been brought to the Museum.

The President exhibited two specimens of *Nicotiana Gossei,* one being a flowering branch taken from a plant four feet high growing in his garden from seed obtained by Professor Cleland in Central Australia, and the other a young

plant. Mr. Black mentioned that a revision of Australian Nicotianas has been undertaken by Professor Goodspeir at the University of California.

Ordinary Meeting, July 12, 1934.

The President (Mr. J. M. Black) in the chair, and 28 members were present.

Minutes of the Ordinary Meeting, held June 14, 1934, were read and confirmed.

Apologies were received from Dr. L. Keith Ward and the Secretary.

Election of Fellow.—Rev. H. A. Gunter, Minister of Religion, 33 Kensington Terrace, Norwood. A ballot was taken, and the President declared the Rev. Gunter elected.

The President referred to the appointment of Dr. J. G. Wood as Professor of Botany at the University of Adelaide. It was agreed that a letter conveying the congratulations of the Society be sent to Dr. Wood.

The Rev. N. H. Louwyck presented to the Society, on behalf of Lady Petrie, two volumes of "Ancient Egypt."

Papers—

"Australian Australites, Part I., Classification of the W. H. C. Shaw Collection," by Chas. Fenner, D.Sc. The paper was illustrated with lantern slides. Sir Douglas Mawson and Professor Kerr Grant took part in the discussion of the paper.

"The Blue-Metal Limestone and its Associated Beds," by T. A. Barnes, B.Sc., and A. W. Kleeman. Sir Douglas Mawson and Dr. C. T. Madigan discussed various points in the paper.

Exhibits—

Sir Douglas Mawson exhibited Tectites collected by Professor La Croix in French Indo-China, which are more regular in shape than Australites, but are of the same chemical composition.

Dr. Robt. H. Pulleine exhibited some primitive implements found near Otago, New Zealand, by Professor Skinner. The piece of green stone was probably used for carving.

Mr. Percy Ifould exhibited some large pieces of compact Tertiary limestone obtained from a road cutting between Tailem Bend and Moorlands which were lying on the surface of the ground, and without any covering of travertine. There was also a good exposure of diorite close by.

Ordinary Meeting, August 9, 1934.

The President (Mr. J. M. Black) in the chair, and 17 members were present.

An apology was received from Dr. L. Keith Ward.

Minutes of the Ordinary Meeting, held July 12, 1934, were read and confirmed.

Papers—

"A Preliminary Account of the Collembola-Arthropleona of Australia, Part II., Superfamily Entomobryoidea," by H. Womersley, F.R.E.S., A.L.S. The paper was discussed by Professor T. Harvey Johnston, Mr. W. J. Kimber, Mr. D. C. Swan, Dr. Chas. Fenner, and the President.

Exhibits—

Dr. Chas. Fenner exhibited five specimens obtained from Mr. H. R. Adamson, of the Mutooroo Pastoral Company. They originally came from the collection made many years ago by Mr. M. B. Ive, who was the General Manager of the Beltana Pastoral Company. The largest specimen consists of sedimentary rock containing large shells which appear to be *Maccoyella* and others. This

specimen probably came from Murnpeowie. The second specimen is a hammer or pestle, consisting of a water-worn pebble attached to portion of a siliceous matrix. This probably came from Wooltana. It has apparently been shaped and used by the aborigines. The third specimen is a silicified ferruginous concretion, and the remaining two specimens appear to be siliceous concretions that have been carried and handled a great deal by aborigines, possibly as ceremonial objects (Murnpeowie). Dr. T. D. Campbell agreed with the suggestion made by Dr. Fenner that the siliceous concretions had probably been handled and carried by aborigines.

Mr. W. J. Kimber exhibited some fossil cephalopods which had been collected from the lower Tertiary beds at the base of the high cliffs north of the jetty at Port Noarlunga in January, 1934, and said that he was fortunate in securing, after careful digging, a fine specimen of the Nautiloid fossil *Aturia Australis* McCoy. This closely resembles *Aturia aturi*, Basterot, found in France and Italy, and also *Aturia ziczac*, Sowerby, of the London clays. Mr. Frederick Chapman, of Melbourne, secured a specimen of *Aturia aturi* from France, and compared it with a representative number of fossils taken in New Zealand, Victoria, and South Australia, and decided that the Australian species was different, and gave it the specific name, Australis. A large specimen exhibited also came from Port Noarlunga. Also two specimens of *Nautilus felix* Chapman (?) The type of this species came from Happy Valley, South Australia. A small fracture in the shell exposes the wonderful chambers similar to those now made by the recent *Nautilus pompilius*. The siphuncle and chambers are covered with crystals.

Mr. J. K. Taylor exhibited a stereoscope possessing some distinct features, and some stereoscopic photographs of the Berri Irrigation areas.

Ordinary Meeting, September 13, 1934.

The President (Mr. J. M. Black) in the chair, and 24 members and visitors were present.

Minutes of the Ordinary Meeting, held August 9, 1934, were read and confirmed.

The President referred to the loss to science by the death of Professor Sir T. W. Edgeworth David, who was an Honorary Fellow of this Society, and Emeritus Professor of Geology at the University of Sydney, and invited Dr. L. Keith Ward to pass on some references and history of Sir Edgeworth David. Dr. Ward then referred to the distinguished career of Sir Edgeworth David, who had been an Honorary Fellow of the Royal Society of South Australia since 1897. Honours had been heaped upon him—by His Majesty the King, and by many Universities and Scientific Societies. He had been closely associated with the administration of the University of Sydney, where he was appointed to the chair of Geology in 1891; of the Association for the Advancement of Science, of which he was twice President; with the Australian Research Council; of the Linnaean Society of New South Wales; of the Royal Society of New South Wales; and of the Australian Museum.

Sir Edgeworth David had taken a leading part also in expeditions to Funafuti on the equator, and to Antarctica. He had visited very many parts of Australia and had made very numerous contributions to our knowledge of the geology of the Commonwealth, particularly in regard to glaciology, stratigraphy, and structural geology, but extending also into petrology and palaeontology.

Apart altogether from his strictly scientific work, Sir Edgeworth David had exercised an extraordinary influence through his power to inspire others and to imbue them with the spirit of research. His gift of eloquence made him much sought after as a public lecturer, so much so that his friends feared many times that he was overtaxing his reserves of strength.

There are very many in Adelaide who will mourn his loss, and none to a greater degree than the Fellows of this Society who, on many occasions, have listened to his expositions.

Dr. Ward then moved:—"That this Society records its deep sense of loss at the death of Sir Edgeworth David who has been an Honorary Fellow of the Society since 1897, and extends its sincerest sympathy to Lady David and the other members of his family. The motion was seconded by Professor T. Harvey Johnston, who paid a tribute to one who had been greatly instrumental in assisting him to follow a scientific career, and with eulogistic remarks endorsed the sentiments expressed by Dr. L. Keith Ward. The motion was supported by Mr. W. H. Selway, and carried by the Members standing.

The President extended a welcome to the Rev. H. A. Gunter and Mr. John Johnstone as new Fellows of the Society, and then welcomed as visitors Mr. Rait (an Entomologist from Canberra), Mrs. Evans (a daughter of Dr. Tillyard, Entomologist, Canberra), and Mr. Wm. Goodhart.

Nomination as Fellow.—Wm. Woide Goodhart, 7 Harrow Road, St. Peters.

Papers—

"Some Australian Anaporrhutine Trematodes," by Professor T. Harvey Johnston, M.A., D.Sc.

"A Revision of the Ipoinea (Homoptera Eurymelidae)," by J. W. Evans, M.A., F.R.E.S.

Exhibits—

Professor J. Burton Cleland exhibited specimens of *Mesembrianthemum (carpobrotus) alquilatems* with the usual purplish-red flowers and also white; *M. (c.) Pulleinei,* a new locality; *M. (Disphyma) australe;* and the *ascledial sarcostemma australe* unusually far south—all collected by Pastor C. Hoff, Emu Downs, via Eudunda.

Also the small fruits of *Cucumis chate,* eaten by the natives from Pandic Pandic on the Diamantina; and a flowering specimen of a species of *Polygonum,* new for the State, growing in mud in the same locality and producing a growth nearly the height of a man, the pith of the stems being eaten by the natives after roasting in hot ashes.

Annual Meeting, October 11, 1934.

The President (Mr. J. M. Black) in the chair, and 29 Members and visitors were present.

Minutes of the Ordinary Meeting, held September 13, 1934, were read and confirmed.

Apologies were received from His Excellency the Governor, and Dr. James Davidson.

The President extended a welcome to Mr. George Aiston, of New Well Station, Mulka, Central Australia.

The President informed the Fellows that His Excellency the Governor, Major-General Sir Winston Joseph Dugan, K.C.M.G., C.B., D.S.O., had graciously consented to act as Patron of the Society during his stay in South Australia.

The Annual Report of the Council for the year 1933-34 was presented by the Secretary.

The Financial Statement and Balance-sheet was presented by the Treasurer, who then moved that it be received and adopted. The motion was seconded by Dr. T. D. Campbell and carried.

Dr. Wm. Christie then moved a vote of thanks to the Auditors for their valuable assistance and services they had rendered to the Society. The vote of thanks was seconded by Dr. Chas. Fenner, and carried.

Election of Officers for the Year 1934-35.—The following nominations for office-bearers were received, and then declared elected by the President:—President, T. D. Campbell, D.D.Sc.; Senior Vice-President, C. T. Madigan, M.A., B.E., D.Sc.; Junior Vice-President, Herbert M. Hale; Secretary, Ralph W. Segnit, M.A., B.Sc.; Treasurer, Wm. Christie, M.B., B.S.; Editor, Chas. A. E. Fenner, D.Sc.; Members of Council, Professor J. Burton Cleland, M.D., and E. H. Ising; Auditors, W. C. Hackett and O. A. Glastonbury.

The Immediate Past President (Mr. J. M. Black) extended his congratulations to his successor in office, Dr. T. D. Campbell, and then moved a vote of thanks to the executive officers of the Society. Their important duties were performed without any other reward than a consciousness of work well done. Mr. Ralph Segnit had served as Hon. Secretary for four years, and it was largely due to his assiduity and enthusiasm that the affairs of the Society ran so smoothly. On Dr. Charles Fenner had fallen the mantle from the shoulders of their dear old friend, Professor Walter Howchin, who had for so many years edited the Transactions and Proceedings of the Society. Their new editor, well known to the scientific world through his publications on the physiography and ethnography of South Australia, possessed all the scholarly attributes which the position demanded. Dr. Christie had for the past year ably filled the office of Hon. Treasurer of the Society, and it was to be hoped that he would for many years continue to do so. Sir Douglas Mawson, who seconded the proposal, also expressed his high appreciation of the services which the executive officers had rendered during the preceding year. The motion was carried by acclamation.

The question of "National Monuments" was then introduced for discussion and consideration of the Fellows by Sir Douglas Mawson, with the view to the matter being brought forward at the next meeting of the Australian and New Zealand Association for the Advancement of Science. Sir Douglas Mawson outlined the history of, and the disappointment felt at, the inactivity displayed by the Commonwealth Government in making the Henbury Craters a closed reserve, and referred to other monuments such as caves inhabited by aborigines, and places where native carvings were being destroyed and removed, which should also be preserved by some Act, and then moved: "That the Delegates from this Society to the Australian and New Zealand Association for the Advancement of Science be empowered to bring forward the question for consideration and action at the next meeting." The motion was seconded by Mr. N. B. Tindale, and carried.

Papers—

Additions to the Flora of South Australia, No. 32, by J. M. Black, A.L.S.

The Munyallina Beds.—A Late Proterozoic Formation, by Sir Douglas Mawson, D.Sc., F.R.S.

Climate in Relation to Insect Ecology in Australia: I. Mean Monthly Precipitation and Atmospheric Saturation Deficit in Australia, by James Davidson, D.Sc.

Australian Fungi; Notes and Descriptions, No. 10, by J. Burton Cleland, M.D.

Notes on the Flora of S.A., No. 3, by E. H. Ising.

On Mammals from the Dawson and Fitzroy Valleys, Central Coastal Queensland, by H. H. Finlayson.

Notes on the Swarming and Metamorphoses of a Central Australian Cicada, Thopa colorata (Distant), by H. H. Finlayson.

The Murray Bridge Granite, by A. W. Kleeman, B.Sc.

The Adamellite from the Granites, Northern Territory, by A. W. Kleeman, B.Sc.

Dr. Wm. Christie then moved a vote of thanks to the Chairman (Mr. J. M. Black) for the services he had rendered the Society during the period he had acted as a Member of the Council, and especially during the past year as President. The motion was seconded by Dr. T. D. Campbell, and carried.

ANNUAL REPORT.

Presented at the Annual Meeting on October 11, 1934.

The average attendance of Fellows at the meetings held during the year has been 27.

The office of Patron of the Society became vacant during the year owing to the departure from the State of His Excellency the Governor, Brig.-General the Hon. Sir A. G. A. Hore-Ruthven, V.C., K.C.M.G., C.B., D.S.O.

His Excellency, Major-General Sir Winston Joseph Dugan, K.C.M.G., C.B., D.S.O., Governor of South Australia, has graciously consented to act as Patron of the Society.

At the meeting held in April, the President presented to Professor J. Burton Cleland the Sir Joseph Verco Medal.

Professor Walter Howchin was elected an Honorary Fellow of this Society in recognition of his distinguished researches and valuable services as an Officer of the Society. He was also elected an Honorary Fellow of the Royal Society of New South Wales.

Dr. C. T. Madigan, a Vice-President of the Society, had the distinguished honour of the degree of Doctor of Science conferred upon him by the University of Oxford.

Professor Walter Howchin received the congratulations of the Society on having been awarded the Lyell Medal by the Geological Society of London.

Dr. J. G. Wood received the congratulations of the Society on his appointment to the Chair of Botany at the University of Adelaide.

Professor Walter Howchin resigned from the office of Editor of the Annual Transactions and Proceedings of the Society, which office he had filled with distinction for more than 40 years.

Dr. Chas. A. E. Fenner was elected to the office of Editor, on the retirement of Professor Walter Howchin.

Dr. T. D. Campbell, a Vice-President of the Society, was re-elected as the Society Representative on the Board of Governors of the Public Library, Museum, and Art Gallery, and resigned from that office in July. Professor Sir Douglas Mawson was elected to fill the vacancy on the Board for the remainder of the year.

Professor J. G. Wood was elected as the Representative Member of this Society on the Fauna and Flora Board to fill the vacancy caused by the death of Mr. M. S. Hawker.

At the Ordinary Meeting held in May, the President announced that Professor Walter Howchin had donated the sum of £40 to the Endowment Fund of this Society.

Professor J. A. Prescott was elected as the Representative Delegate of this Society to the Centenary Celebrations of the Geological Society of Edinburgh.

Dr. B. G. Maegraith and Dr. A. J. Lewis were elected as Delegates from this Society to the International Congress of Anthropological and Ethnological Sciences held in London from July 30 to August 4, 1934.

Dr. Chas A. E. Fenner and Dr. T. D. Campbell were elected as Delegates from this Society to the meeting of the A.N.Z.A.A.S., to be held in Melbourne in 1935.

The following Fellows of this Society took part in the Adelaide University and Museum Anthropological Expedition to Central Australia:—Dr. T. D. Campbell (Leader), Professor J. Burton Cleland, Professor T. Harvey Johnston, Dr. H. K. Fry, and Mr. N. B. Tindale.

During the year the Council gave consideration to the question of obtaining additional space in the crypt for the expansion of the Library, and to the matter of obtaining a new lantern and episcope for the use of the Society and Scientific bodies using the Society rooms.

The Ordinary Meeting of the Society, held in June, was devoted to Exhibits.

Papers.—Botanical papers were read by Mr. J. M. Black, Professor J. Burton Cleland, and Mr. E. H. Ising.

Geological papers were read by Professor Sir Douglas Mawson, Dr. Chas. Fenner, Mr. A. W. Kleeman, and two conjoint papers by Messrs. T. A. Barnes and A. W. Kleeman.

A Soil Survey paper was presented by Dr. James Davidson on behalf of Professor J. A. Prescott.

Anthropological papers were read by Dr. T. D. Campbell and Dr. H. K. Fry.

Two Entomological papers were read by Mr. H. Womersley, and one by Mr. J. W. Evans.

A Zoological paper was presented by Professor T. Harvey Johnston.

Papers on Climatology were read by Professor J. A. Prescott, and two by Dr. James Davidson.

A Physical paper was read by Mr. Edwin Ashby.

During the year the Society has suffered loss by death of Professor Sir Edgeworth David, an Honorary Fellow of the Society, who died in August. An Obituary Notice appears elsewhere in this volume.

The membership of the Society shows an increase. The number of Fellows elected during the year being 8. Three Fellows resigned, and one died. The Membership Roll at the close of the financial year is:—Honorary Fellows, 4; Fellows, 171; Associate, 1. Total, 176.

J. M. Black, *President.*

Ralph W. Segnit, *Secretary.*

THE SIR JOSEPH VERCO MEDAL.

The Council, on August 23, 1928, having resolved to recommend to the Fellows of the Society that a medal should be founded to give honorary distinction for scientific research, and that it should be designated the Sir Joseph Verco

Medal, was submitted to the Society at the evening meeting of October 11, 1928, and at a later meeting, held on November 8, 1928, when the recommendation of the Council was confirmed on the following terms:—

REGULATIONS.

XI.—"The medal shall be of bronze, and shall be known as the Sir Joseph Verco Medal, in recognition of the important service that gentleman has rendered to the Royal Society of South Australia. On the obverse side of the medal shall be these words: 'The Sir Joseph Verco Medal of the Royal Society of South Australia,' surrounding the modelled portrait of Sir Joseph Verco, while on the reverse side of the medal there shall be a surrounding wreath of eucalypt, with the words: 'Awarded to ....for Research in Science,' the name of the recipient, and the year of the award. The Council shall select the person to whom it is suggested that the medal shall be awarded, and that name shall be submitted to the Fellows at an Ordinary Meeting to confirm, or otherwise, the selection of the Council, by ballot or show of hands. The medal shall be awarded for distinguished scientific work published by a Member of the Royal Society of South Australia."

AWARDS.

1929 PROF. WALTER HOWCHIN, F.G.S.
1930 JOHN McC. BLACK.
1931 PROF. SIR DOUGLAS MAWSON, B.E., D.Sc., F.R.S.
1933 PROF. J. BURTON CLELAND, M.D.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Receipts and Payments for the Year ended September 30, 1934.

RECEIPTS.

	£	s.	d.	£	s.	d.
To Balance, October 1, 1933				744	3	7
„ Subscriptions				131	8	0
„ Use of Room by other Societies	9	4	0			
„ Sale of Publications	6	19	7			
„ Exchange, etc.	0	3	0			
				16	6	7
„ Endowment Fund (Contra)—						
Professor Walter Howchin	40	0	0			
Anonymous Donation	5	5	0			
				45	5	0
„ Interest—						
Savings Bank Account	19	0	0			
Transferred from Endowment Fund	149	1	2			
				168	1	2
				£1,105	4	4

PAYMENTS.

				£	s.	d.	£	s.	d.
By Transactions—									
Printing				233	9	4			
Illustrating				26	1	6			
Publishing				5	0	9			
							264	11	7
„ Library—									
Librarian				40	12	6			
Cartage on Books				0	16	11			
							41	9	5
„ Sundries—									
Cleaning and Lighting				10	1	3			
Printing, Postages and Stationery				28	4	4			
Petties				3	15	0			
Insurance				6	15	0			
Cheque Book and Bank Fee				0	10	0			
Projector Repairs				2	12	6			
							51	18	1
„ Research Fund							20	0	0
„ Endowment Fund (Contra)							45	5	0
„ Balance, September 30, 1934—									
Savings Bank of S.A.				613	12	8			
Bank of Australasia	£72	7	7						
Less Outstanding Cheques	4	0	0						
				68	7	7			
							682	0	3
							£1,105	4	4

Audited and found correct,

W. CHAMPION HACKETT }
O. GLASTONBURY, A.A.I.S., A.F.I.A. } Hon. Auditors.

W. CHRISTIE, Hon. Treasurer.

Adelaide, October 9, 1934.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

(a) ENDOWMENT FUND as at **September 30, 1934.**

(Capital £4,331 18 7d.)

	£ s. d.	£ s. d.
1933—October 1.		
To Balance—		
Australian Consolidated Stock	4,280 0 0	
Savings Bank of S.A.	6 13 7	
		4,286 13 7
„ Professor Walter Howchin, F.G.S.	40 0 0	
„ Anonymous Donation	5 5 0	
		45 5 0
„ Interest Received		149 1 2
		£4,480 19 9

	£ s. d.	£ s. d.
1934—September 30.		
By Revenue Account		149 1 2
„ Australian Consolidated Stock at Face Value	4,280 0 0	
„ Savings Bank Account	46 13 7	
„ Bank of Australasia	5 5 0	
		4,331 18 7
		£4,480 19 9

(b) RESEARCH FUND as at **September 30, 1934.**

	£ s. d.	£ s. d.
1934.		
March 24—To General Revenue	10 0 0	
June 6— „ „ „	10 0 0	
		20 0 0
		£20 0 0

	£ s. d.	£ s. d.
1934.		
Sept. 30—By Grants in Aid of Research Work—		
H. H. Finlayson .	10 0 0	
T. H. Colquhoun ..	5 0 0	
		15 0 0
„ Balance—Savings Bank of S.A.		5 0 0
		£20 0 0

Audited and found correct. We have verified the Government Stocks at the Registries of Inscribed Stock, Adelaide.

W. CHAMPION HACKETT } Hon.
O. GLASTONBURY, A.A.I.S., A.F.I.A. } Auditors.

W. CHRISTIE, Hon. Treasurer.

Adelaide, October 9, 1934.

ENDOWMENT FUND

Summary

THE ENDOWMENT FUND.

1902.—On the motion of the late Samuel Dixon it was resolved that steps be taken for the incorporation of the Society and the establishment of an Endowment and Scientific Research Fund. Vol. xxvi., pp. 327-8.

1903.—The incorporation of the Society was duly effected and announced. Vol. xxvii., pp. 314-5.

1905.—The President (Dr. J. C. Verco) offered to give £1,000 to the Fund on certain conditions. Vol. xxix., p. 339.

1929.—The following are particulars of the contributions received and other sources of revenue in support of the Fund up to date:—

SUMMARY OF THE ENDOWMENT FUND (30/8/34).

(Capital £4,331 18s. 7d.)

	£	s.	d.	£	s.	d.	£	s.	d.
Donations—									
1908, Dr. J. C. Verco	1,000	0	0						
1908, Thomas Scarfe	1,000	0	0						
1911, Dr. Verco	150	0	0						
1913, Dr. Verco	120	0	0						
Mrs. Ellen Peterswald	100	0	0						
1934, Prof. Walter Howchin, F.G.S.	40	0	0						
"Anonymous"	5	5	0						
Small Sums	6	0	0						
				2,421	5	0			
Bequests—									
1917, R. Barr Smith .	1,005	16	8						
1920, Sir Edwin Smith	200	0	0						
				1,205	16	8			
Life Members' Subscriptions				225	0	0			
							3,852	1	8
Total Subscribed Capital							£3,852	1	8

Additions from the Current Account have been made at various dates. These have enabled the Society to purchase Government Stocks amounting to (face value) £4,280. Cash in hand on account of the Endowment Fund amounts to £51 18s. 7d. The total capital of this Fund is, therefore, £4,331 18s. 7d.

GRANTS MADE IN AID OF SCIENTIFIC RESEARCH.

	£	s.	d.
1916, G. H. Hardy, "Investigations into the Flight of Birds"	15	0	0
1916, Miss H. A. Rennie, "Biology of *Lobelia gibbosa*"	2	2	0
1921. H. R. Marston, "Possibility of obtaining from Azine precipitate samples of pure Proteolytic Enzymes"	30	0	0
1921, Prof. Wood Jones, "Investigations of the Fauna and Flora of Nuyts Archipelago"	44	16	7
1934. H. H. Finlayson, "Mammals of Central Australia"	10	0	0
1934. T. T. Colquhoun, M.Sc., "Regeneration of Vegetation after Bush-fires"	5	0	0

W. CHRISTIE, Hon. Treasurer.

ROYAL SOCIETY LIBRARY.

List of Governments, Societies and Editors with whom Exchanges of Publications are made.

AUSTRALIA.

Australasian Institute of Mining and Metallurgy, Melbourne.
Bureau of Census and Statistics, Canberra.
Council for Scientific and Industrial Research, Melbourne.
Library of Commonwealth Parliament.

SOUTH AUSTRALIA.

Botanic Garden, Adelaide.
Mines Department, Adelaide.
Public Library, Museum, and Art Gallery of South Australia.
Royal Geographical Society of Australasia (S.A. Branch).
South Australian Institutes Association, Adelaide.
South Australian Museum, Adelaide.
South Australian Naturalist, Adelaide.
South Australian Ornithologist, Adelaide.
South Australian Parliamentary Library.
University of Adelaide.
Waite Agricultural Research Institute, Glen Osmond.

NEW SOUTH WALES.

Australian Museum, Sydney.
Botanic Gardens, Sydney.
Department of Agriculture, Sydney.
Linnean Society of New South Wales.
Mines Department, Sydney.
Public Library of New South Wales.
Royal Society of New South Wales.
Royal Zoological Society of New South Wales.
School of Public Health and Tropical Medicine, Sydney.
Technological Museum, Sydney.
University of Sydney.

QUEENSLAND.

Department of Agriculture, Brisbane.
Geological Survey, Brisbane.
Queensland Museum, Brisbane.
Public Library of Queensland, Brisbane.
Royal Society of Queensland, Brisbane.
University of Queensland, Brisbane.

TASMANIA.

Government Geologist, Mines Department, Hobart.
Public Library of Tasmania, Hobart.
Royal Society of Tasmania, Hobart.
University of Tasmania, Hobart.

VICTORIA.

Field Naturalists' Club of Victoria, Melbourne.
Government Botanist, National Herbarium, Melbourne.
Mines Department, Melbourne.
National Museum, Melbourne.
Public Library of Victoria, Melbourne.
Royal Society of Victoria, Melbourne.
University of Melbourne.

WESTERN AUSTRALIA.

Geological Survey Department, Perth.
Public Library of Western Australia, Perth.
Royal Society of Western Australia, Perth.
University of Western Australia, Perth.

ENGLAND.

British Museum Library, London.
British Museum (Natural History), South Kensington.
Cambridge Philosophical Society.
Cambridge University Library.
Conchological Society of Great Britain and Ireland.
Geological Society of London.
Geologists' Association, London.
Hill Museum, Witley, Surrey.
Imperial Institute, South Kensington.
Imperial Institute of Entomology, London.
Linnean Society of London.
Liverpool Biological Society.
Manchester Literary and Philosophical Society.
National Physical Laboratory, Teddington.
Rhodes House Library, Oxford.
Rothamsted Experimental Station, Harpenden.
Royal Botanic Gardens, Kew.
Royal Empire Society, London.
Royal Entomological Society of London.
Royal Geographical Society, London.
Royal Microscopical Society, London.
Royal Society, London.
Science Museum, South Kensington.
Zoological Museum, Tring, Herts.
Zoological Society of London.

SCOTLAND.

Edinburgh Geological Society.
Geological Society of Glasgow.
Royal Society of Edinburgh.

IRELAND.

Royal Dublin Society.
Royal Irish Academy, Dublin.

ARGENTINE REPUBLIC.

Academia Nacional de Ciencias, Cordoba.
Universidad de Buenos Aires.

AUSTRIA.

Akademie der Wissenschaften, Vienna.
Geologische Bundesanstalt, Vienna.
Naturhistorisches Museum, Vienna.
Zoologisch-Botanische Gesellschaft, Vienna.

BELGIUM.

Académie Royale de Belgique, Brussels.
Institut Solvay, Brussels.
Musée Royale d'Histoire Naturelle de Belgique, Brussels.
Société Entomologique de Belgique, Ghent.
Société Royale de Botanique de Belgique, Brussels.
Société Royale des Sciences de Liège.
Société Royale Zoologique de Belgique, Brussels.

BRAZIL.

Instituto Oswaldo Cruz, Rio de Janeiro.
Museu Paulista, Sao Paulo.

CANADA.

Canadian Geological Survey, Ottawa.
Department of Agriculture, Ottawa.
National Research Council of Canada, Ottawa.
Nova Scotian Institute of Science, Halifax.
Royal Canadian Institute, Toronto.
Royal Society of Canada, Ottawa.
University of British Columbia, Vancouver.

CEYLON.

Colombo Museum, Colombo.

CHINA.

Geological Survey of China, Peiping.
Institute of Biology, National Library of Peiping.
Metropolitan Museum of Natural History, Nanking.
Science Society of China, Nanking.
Shanghai Science Institute, Shanghai.
Sun Yatsen University, Canton.

CZECHO-SLOVAKIA.

Ceskoslovenska Botanicka Spolecnost, Prague.

DENMARK.

Conseil Permanent International pour l'Exploration de la Mer.
Dansk Naturhistorisk Forening. Copenhagen.
Kobenhavn Universitets Zoologiske Museum.
K. Danske Videnskabernes Selskab. Copenhagen.

ESTHONIA.

Universitas Tartuensis, Tartu (Dorpat).

FEDERATED MALAY STATES.

Royal Asiatic Society, Malayan Branch, Singapore.

FINLAND.

Academia Scientiarum Fennica, Helsinki.
Societas Entomologica Helsingforsiensis.
Societas Scientiarum Fennica, Helsingfors.

FRANCE.

Muséum National d'Histoire Naturelle, Paris.
Société Bourguignonne d'Histoire Naturelle et de Préhistoire, Toulouse.
Société des Sciences Naturelles de l'Ouest de la France, Nantes.
Société Entomologique de France, Paris.
Société Géologique de France, Paris.
Société Linnéenne de Bordeaux.
Societe Linnéenne de Normandie, Caen.

GERMANY.

Bayerische Akademie der Wissenschaften zu München.
Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte.
Botanischer Garten und Botanisches Museum, Berlin.
Fedde, F.: Repertorium specierum novarum regni vegetabilis, Berlin.
Gesellschaft der Wissenschaften zu Göttingen.
Gesellschaft für Erdkunde zu Berlin.
K. Leopoldinische Deutsche Akademie der Naturforscher, Halle.
Naturforschende Gesellschaft, Freiburg.
Preussische Akademie der Wissenschaften, Berlin.
Senckenbergische Bibliothek, Frankfürt a. M.
Zoologisches Museum, Berlin.
Zoologisches Staatsinstitut und Zoologisches Museum, Hamburg.

HAWAIIAN ISLANDS.

Bernice Pauahi Bishop Museum, Honolulu.
Hawaiian Entomological Society, Honolulu.

HOLLAND.

Musée Teyler, Haarlem.
Rijks Herbarium, Leiden.

HUNGARY.

Hydrological Dept., Hungarian Geological Soc., Budapest.
Musée National Hongrois, Budapest.

INDIA.

Government Museum, Madras.
Geological Survey of India, Calcutta.
Royal Asiatic Society, Bombay Branch, Bombay.
Zoological Survey of India, Calcutta.

ITALY.

Laboratorio di Entomologia, Bologna.
Laboratorio di Zoologia Agraria, Milan.
Laboratorio di Zoologia Generale e Agraria, Portici.
Società di Scienze Naturali ed Economiche, Palermo.
Società Entomologica Italiana, Genova.
Società Italiana di Scienze Naturali, Milan.
Società Toscana di Scienze Naturali, Pisa.

JAPAN.

Hiroshima University.
Kyōto Imperial University.
Ohara Institute for Agricultural Research, Kurashiki.
Taihoku Imperial University.
Tokyo Imperial University.

MEXICO.

Instituto de Biologia, Chapultepec.
Instituto Geológico de Mexico.
Sociedad Cientifica "Antonio Alzate," Mexico.

NEW ZEALAND.

Auckland Institute and Museum.
Dominion Museum, Wellington.
Royal Society of New Zealand, Wellington.
Otago University Museum, Dunedin.
Philosophical Institute of Canterbury, Christchurch.

NORWAY.

Bergen Museum, Bergen.
Botanisk Museum, Oslo.
Kongelige Norske Videnskabers Selskabs, Trondheim
Tromso Museum, Tromso.

PHILIPPINE ISLANDS.

Philippine Journal of Science, Manila.

POLAND.

Société Botanique de Pologne, Warsaw.
Société Polonaise des Naturalistes "Kopernik," Lwow.

RUSSIA.

Académie des Sciences, Leningrad.
Comité Géologique de Russie, Leningrad.
Institute of Plant Industry, Leningrad.
Siberian Mining Institute, Irkutsk.

SPAIN.

Academia de Ciencias y Artes, Barcelona.
Instituto Nacional de Segunda Enseñanza de Valencia.

SWEDEN.

Entomologiska Föreningen i Stockholm.
Geologiska Föreningen, Stockholm.
Stockholm's Högskolas Bibliotek, Stockholm.
Regia Societas Scientiarum Upsaliensis, Upsala.

SWITZERLAND.

Naturforschende Gesellschaft, Basel.
Société de Physique et d'Histoire Naturelle de Genève.
Société Neuchâteloise des Sciences Naturelles, Neuchâtel.
Société Vaudoise des Sciences Naturelles, Lausanne.
Zentralbibliothek, Zürich.

UNION OF SOUTH AFRICA.

Albany Museum, Grahamstown.
Geological Society of South Africa, Johannesburg.
Royal Society of South Africa, Cape Town.
South African Museum, Cape Town.
South African Association for the Advancement of Science, Johannesburg.

UNITED STATES.

Academy of Natural Sciences of Philadelphia.
Academy of Science of St. Louis.
American Academy of Arts and Sciences, Boston.
American Chemical Society, Columbus, O.
American Geographical Society, New York.
American Microscopical Society, Manhattan, Kans.
American Museum of Natural History, New York.
American Philosophical Society, Philadelphia.
Arnold Arboretum, Jamaica Plain, Mass.
Biological Survey of the Mount Desert Region, Bar Harbour, Me.
Boston Society of Natural History, Boston, Mass.
Brooklyn Institute of Arts and Sciences.
California Academy of Sciences, San Francisco.
Californian State Mining Bureau, San Francisco.
California, University of, Berkeley, Cal.
Chicago Academy of Sciences.
Citrus Experiment Station, Riverside, Cal.
Connecticut State Library, Hartford, Conn.
Cornell University, Ithaca, N.Y.
Denison Scientific Association, Granville, O.
Field Museum of Natural History, Chicago, Ill.
Franklin Institute of the State of Pennsylvania, Philad.
Harvard Museum of Comparative Zoology, Cambridge, Mass.
Illinois State Natural History Survey, Urbana, Ill.
Illinois University Library, Urbana, Ill.
Indiana Academy of Science, Indianapolis.
Johns Hopkins University, Baltimore, Md.
Kansas University, Lawrence, Kans.
Marine Biological Laboratory, Wood's Hole, Mass.
Maryland Geological Survey, Baltimore, Md.
Michigan University, Chicago.
Missouri Botanical Garden Library, St. Louis, Mo.
Missouri, University of, Columbia.
National Academy of Science, Washington, D.C.
National Geographic Society, Washington, D.C.
New York Academy of Sciences, New York.
New York Public Library.
New York State Library, Albany, N.Y.
Ohio State University Library, Columbus, O.
Princeton University, Princeton, N.J.
San Diego Society of Natural History, San Diego, Cal.
Smithsonian Institution and Bureau of Ethnology, Washington.
United States Department of Agriculture, Washington, D.C.
United States Geological Survey, Washington, D.C.
United States National Museum, Washington, D.C.
Wagner Free Institute of Science, Philadelphia, Pa.
Washington University, St. Louis, Mo.
West Virginia University, Morgantown, W. Va.
Yale University Library, New Haven, Conn.

URUGUAY.

Museo de Historia Natural, Montevideo.

LIST OF FELLOWS, MEMBERS, ETC.

Summary

LIST OF FELLOWS, MEMBERS, ETC.

AS EXISTING ON SEPTEMBER 30, 1934.

Those marked with an asterisk (*) have contributed papers published in the Society's Transactions. Those marked with a dagger (†) are Life Members.

Any change in address or any other changes should be notified to the Secretary.

Note.—The publications of the Society will not be sent to those whose subscriptions are in arrear.

Date of Election.

HONORARY FELLOWS.

1910. *BRAGG, SIR W. H., O.M., K.B.E., M.A., D.C.L., LL.D., D.Sc., F.R.S., Director of the Royal Institution, Albemarle Street, London (Fellow 1886).
1926. *CHAPMAN, F., A.L.S., National Museum, Melbourne.
1898. *MEYRICK, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1894. *WILSON, J. T., M.D., Ch.M., F.R.S., Professor of Anatomy, Cambridge University, England.

FELLOWS.

1926. ABELL, L. M., Chapman Camp, British Columbia.
1925. ADEY, W. J., 32 High Street, Burnside, S.A.
1927. *ALDERMAN, A. R., M.Sc., F.G.S., West Terrace, Kensington Gardens, S.A.
1931. ANDREW, REV. J. R., Methodist Mission, Salamo, via Samarai, Papua.
1929. ANGEL, FRANK M., 34 Fullarton Rd., Parkside.
1895. †*ASHBY, EDWIN, F.L.S., M.B.O.U., Blackwood, S.A.—**Council,** 1900-19; **Vice-President,** 1919-21.
1902. *BAKER, W. H., Ningana Avenue, King's Park, S.A.
1933. *BARNES, T. A. B.Sc., 13 Leah Street, Forestville.
1926. BECK, B. B., 127 Fullarton Road, Myrtle Bank, S.A.
1932. BEGG, P. R., B.D.Sc., L.D.S., 219 North Terrace, Adelaide.
1928. BEST, R. J., M.Sc., A.A.C.I., Waite Agricultural Research Institute, Glen Osmond.
1928. *BEST, Mrs. E. W., M.Sc., Claremont, Glen Osmond.
1931. BIRCH, H. McI., M.R.C.S., M.R.C.P., D.P.M., Mental Hospital, Parkside.
1930. BIRKS, W. R., B.Sc., 7 Kensington Road, Kensington.
1934. BLACK, E. C., M.B., B.S., Magill Road, Tranmere.
1907. *BLACK, J. M., A.L.S., 82 Brougham Place, North Adelaide—**Sir Joseph Verco Medal,** 1930; **Council,** 1927-1931; **President,** 1933-34; **Vice-President,** 1931-33.
1924. BROWNE, J. W., B.Ch., 169 North Terrace, Adelaide.
1923. BURDON, ROY S., B.Sc., University of Adelaide.
1921. BURTON, R. J., c/o P.O., Kalgoorlie, W.A.
1922. *CAMPBELL, T. D., D.D.Sc., Dental Dept., Adelaide Hospital, Frome Road, Adelaide—**Rep.-Governor** ,1932-33; **Council,** 1928-32; **Vice-President,** 1932-34; **President,** 1934-.
1907. *CHAPMAN, R. W., C.M.G., M.A., B.C.E., F.R.A.S., Professor of Engineering and Mechanics, University, Adelaide—**Council,** 1914-22.
1931. *CHEWINGS, CHAS., Ph.D., F.G.S., "Alverstroke," Claremont Road, Glen Osmond.
1929. CHRISTIE, W., M.B., B.S., Education Department, Flinders Street, Adelaide—**Treasurer,** 1933-.
1930. CLARKE, G. H., B.Sc., Agricultural College, Roseworthy.
1895. *CLELAND, JOHN B., M.D., Professor of Pathology, University, Adelaide—**Sir Joseph Verco Medal,** 1933; **Council,** 1921-26, 1932-; **President,** 1927-28; **Vice-President,** 1926-27.
1930. COLLINS, F. V., B.V.Sc., Green Road, Woodville.
1930. *COLQUHOUN, T. T., M.Sc., University, Adelaide.
1907. *COOKE, W. T., D.Sc., A.A.C.I., Lecturer, University of Adelaide.
1929. *COTTON, BERNARD C., S.A. Museum, Adelaide.
1924. DE CRESPIGNY, C. T. C., D.S.O., M.D., F.R.C.P., 219 North Terrace, Adelaide.
1929. DAVIDSON, JAMES, D.Sc., Waite Agricultural Research Institute, Glen Osmond - **Council,** 1932-.
1928. DAVIES, J. G., B.Sc., Ph. D., Waite Agricultural Research Institute, Glen Osmond.
1927. *DAVIES, Prof. E. HAROLD, Mus.Doc., The University, Adelaide.
1930. DIX, E. V., Glynde Road, Firle.
1915. *DODD, ALAN P., Prickly Pear Laboratory, Sherwood, Brisbane.
1932. DUNSTONE, H. E., M.B., B.S., J.P., 124 Payneham Road, St. Peters.
1921. DUTTON, G. H., B.Sc., 18 Austral Terrace, Malvern.
1931. DWYER, J. M., M.B., B.S., Adelaide Hospital.
1933. EARDLEY, Miss C. M., B.Sc., 68 Wattle Street, Fullarton Estate.
1902. *EDQUIST, A. G., 19 Farrell Street, Glenelg.
1918. *ELSTON, A. H., F.E.S., "Llandyssil," Aldgate.

Date of Election.

1925. England, H. N., B.Sc., Commonwealth Research Station, Griffith, N.S.W.
1932. *Evans, J. W., M.A., Waite Agricultural Research Institute, Glen Osmond.
1917. *Fenner, Chas. A. E., D.Sc., 42 Alexander Avenue, Rose Park—**Rep.-Governor**, 1929-31; **Council**, 1925-28; **President**, 1930-31; **Vice-President**, 1928-30; **Secretary**, 1924-25; **Treasurer**, 1932-33; **Editor**, 1934-.
1927. *Finlayson, H. H., The University of Adelaide.
1929. Freney, M. Raphael.
1929. Freney, M. Richard.
1931. Frewin, O. W., M.B., B.S., Woodville.
1923. *Fry, H. K., D.S.O., M.B., B.S., B.Sc., Glen Osmond Road, Parkside—**Council**, 1933-.
1930. Garrett, S. D., B.A., Waite Agricultural Research Institute, Glen Osmond.
1932. *Gibson, E. S. H., B.Sc., 297 Cross Roads, Clarence Gardens.
1919. †Glastonbury, O. A., Adelaide Cement Co., Brookman Buildings, Grenfell Street.
1923. Glover, C. R. J., Stanley Street, North Adelaide.
1927. Godfrey, F. K., Robert Street, Payneham, S.A.
1934. Goodhart, W. W., 7 Harrow Road, St. Peters.
1904. Gordon, David, 72 Third Avenue, St. Peters.
1925. †Gosse, J. H., Gilbert House, Gilbert Place, Adelaide.
1880. *Goyder, George, A.M., B.Sc., F.G.S., 232 East Terrace, Adelaide.
1910. *Grant, Kerr, M.Sc., Professor of Physics, University, Adelaide—**Council**, 1912-15.
1933. Gray, James H., M.B., B.S., Adelaide Hospital.
1930. Gray, James T., Orroroo, S.A.
1933. Greaves, H., Director, Botanic Garden, Adelaide.
1904. Griffith, H., Hove, Brighton.
1934. Gunter, Rev. H. A., 33 Kensington Terrace, Norwood.
1916. Hackett, W. Champion, 35 Dequetteville Terrace, Kent Town.
1927. *Hackett, Dr. C. J., 196 Prospect Road, Prospect, S.A.
1922. *Hale, H. M., The Director, S.A. Museum, Adelaide—**Council**, 1931-34; **Vice-President**, 1934-.
1930. Hall, F. J., Adelaide Electric Supply Coy., Ltd., Adelaide.
1922. *Ham, William, F.R.E.S., 112 Edward Street, Norwood.
1916. †Hancock, H. Lipson, A.M.I.C.E., M.I.M.M., A.Am.I.M.E., Bewdley, 66 Beresford Road, Bellevue Hill, Rose Bay, Sydney.
1924. Hawker, Captain C. A. S., M.A., M.H.R., Dillowie, Hallett, South Australia.
1923. Hill, Florence McCoy M., B.S., M.D., Elizabeth Street, Sydney, N.S.W.
1927. Holden, E. W., B.Sc., Dequetteville Terrace, Kent Town, S.A.
1933. Hosking, H. C., B.A., 24 Northcote Terrace, Gilberton.
1929. Hosking, John W., 77 Sydenham Road, Norwood.
1930. Hosking, J. S., B.Sc., Waite Agricultural Research Institute, Glen Osmond.
1924. *Hossfeld, Paul S., M.Sc., Office of Home and Territories, Canberra.
1883. *Howchin, Professor Walter, F.G.S., "Stonycroft," Goodwood East—**Sir Joseph Verco Medal**, 1929; **Rep.-Governor**, 1901-22; **Council**, 1883-84, 1887-89, 1890-94, 1902-; **President**, 1894-96; **Vice-President**, 1884-87, 1889-90, 1896-1902; **Editor**, 1883-88, 1893-94, 1895-96, 1901-1933.
1928. Hurcombe, Miss J. C., 95 Unley Road, New Parkside.
1928. Ifould, Percy, Kurralta, Burnside.
1918. *Ising, Ernest H., c/o Comptroller's Office, S.A. Railways, Adelaide—**Council**, 1934-.
1918. *Jennison, Rev. J. C., Goolwa.
1910. *Johnson, E. A., M.D., M.R.C.S., Town Hall, Adelaide.
1934. Johnston, J., A.S.A.S.M., 32 Fisher Street, Norwood.
1921. *Johnston, Professor T. Harvey, M.A., D.Sc., University, Adelaide—**Rep.-Governor**, 1927-29; **Council**, 1926-28; **Vice-President**, 1928-31; **President**, 1931-32.
1929. Johnston, W. C., Government Agricultural Inspector, Riverton.
1920. *Jones, Professor F. Wood, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., F.R.S., University, Melbourne—**Rep.-Governor**, 1922-27; **Council**, 1921-25; **President**, 1926-27; **Vice-President**, 1925-26.
1918. Kimber, W. J., 28 Second Avenue, Joslin.
1933. *Kleeman, A. W., B.Sc., 12 Ningara Avenue, Kings Park.
1915. *Laurie, D. F., Agricultural Department, Flinders Street, Adelaide.
1930. Le Messurier, D. H., B.Sc., 133 Mills Terrace, North Adelaide.
1884. Lendon, A. A., M.D., M.R.C.S., 66 Brougham Place, North Adelaide.
1922. Lendon, Guy A., M.B., B.S., M.R.C.P., North Terrace.
1925 Lewis, A. J., M.D., B.S., The Maudsley Hospital, Denmark Hill, London, S.E. 5.
1930. Louwyck, Rev. N. H., The Rectory, Yankalilla.
1922. *Madigan, C. T., M.A., B.E., D.Sc., F.G.S., University of Adelaide—**Council**, 1930-33; **Vice-President**, 1933-.
1923. Marshall, J. C., Darrock, Payneham.

Date of Election.

1928. *Maegraith, B. G., M.B., B.S., Magdalen College, Oxford, England.
1930. Magarey, Miss K. de B., B.A., B.Sc., 38 Winchester Street, Malvern.
1932. Mann, E. A., C/o Bank of Adelaide, Adelaide.
1929. Martin, F. C., M.A., Technical High School, Thebarton.
1905. *Mawson, Sir Douglas, D.Sc., B.E., F.R.S., Professor of Geology, University, Adelaide **Sir Joseph Verco Medal,** 1931; **Rep.-Governor,** 1933; **President,** 1924-25; **Vice-President,** 1923-24, 1925-26.
1919. Mayo, Helen M., M.D., 47 Melbourne Street, North Adelaide.
1920. Mayo, Herbert, LL.B., K.C., 16 Pirie Street, Adelaide.
1934. McCloughry, C. L., B.E., A.M.I.E. (Aust.), 271 Melbourne Street, North Adelaide.
1929. McLaughlin, E., M.B., B.S., M.R.C.P., Adelaide Hospital.
1907. Melrose, Robert T., Mount Pleasant.
1930. Miller, J. I., 18 Ralston Street, Largs Bay.
1925. †Mitchell, Professor Sir William, K.C.M.G., M.A., D.Sc., The University, Adelaide.
1930. Mitchell, Miss U. H., B.Sc., Presbyterian Girls' College, Glen Osmond.
1930. Mitchell, M. L., B.Sc., Fitzroy Terrace, Prospect.
1924. Morison, A. J., Deputy Town Clerk, Town Hall, Adelaide.
1930. Morris, L. G., Beehive Buildings, King William Street, Adelaide.
1925. †Murray, Hon. Sir George, K.C.M.G., B.A., LL.M., Magill, S.A.
1925. North, Rev. Wm. O., Methodist Manse, Netherby.
1930. Ockenden, G. P., Public School, Streaky Bay, S.A.
1932. Oliphant, H. R., University, Adelaide.
1913. *Osborn, T. G. B., D.Sc., Professor of Botany, University, Sydney—**Council,** 1915-20, 1922-24; **President,** 1925-26; **Vice-President,** 1924-25, 1926-27.
1927. Paltridge, T. B., B.Sc., Koonamore, via Waukaringa, S.A.
1929. Pank, Harold G., 75 Rundle Street, Adelaide.
1929. Paull, Alec. G., B.A., B.Sc., 10 Milton Avenue, Fullarton Estate.
1924. Pearce, C., Happy Valley Reservoir, O'Halloran Hill.
1924. Perkins, Professor A. J., Director of Agriculture, Flinders Street, Adelaide.
1928. Phipps, Ivan F., Ph.D., Waite Agricultural Research Institute, Glen Osmond.
1926. *Piper, C. S., M.Sc., Waite Agricultural Research Institute, Glen Osmond.
1925. *Prescott, Professor J. A., D.Sc., A.I.C., Waite Agricultural Research Institute, Glen Osmond—**Council,** 1927-30; **Vice-President,** 1930-32; **President,** 1932-33.
1926. Price, A. Grenfell, C.M.G., M.A., Litt.D., F.R.G.S., St. Mark's College, North Adelaide.
1907. †*Pulleine Robert H., M.B., Ch.M., North Terrace, Adelaide—**Council,** 1914-19, 1932-; **President,** 1922-24; **Vice-President,** 1912-14, 1919-22, 1924-25; **Secretary,** 1909-12, 1925-30.
1925. Richardson, Professor A. E. V., M.A., D.Sc., "Urrbrae," Glen Osmond, S.A.
1926. *Riddell, P. D., Technical College, Newcastle, N.S.W.
1911. *Roach, B. S., 81 Kent Terrace, Kent Town—**Treasurer,** 1920-32.
1925. Rogers, L. S., B.D.Sc., 192 North Terrace, Adelaide.
1905. *Rogers, R. S., M.A., M.D., F.L.S., 52 Hutt Street, Adelaide—**Council,** 1907-14, 1919-21; **President,** 1921-22; **Vice-President,** 1914-19, 1922-24.
1931. Rudd, E. A., 10 Church Street, Highgate.
1928 Scott, A. E., B.Sc., Waite Agricultural Research Institute, Glen Osmond.
1934. Shinkfield, R. C., Meteorological Bureau, West Terrace, Adelaide.
1930. Schneider, M., M.B., B.S., 175 North Terrace, Adelaide.
1924. *Segnit, Ralph W., M.A., B.Sc., Assistant Government Geologist, Flinders Street, Adelaide—**Secretary,** 1930-.
1891. Selway, W. H., 14 Frederick Street, Gilberton—**Council,** 1893-1909.
1930. Service, A. D., c/o Colonial Sugar Refinery Co., New Farm, Brisbane.
1926. *Sheard, Harold, Nuriootpa.
1928. Showell, H., 27 Dutton Terrace, Medindie.
1920. Simpson, A. A., C.M.G., C.B.E., F.R.G.S., Lockwood Road, Burnside.
1924. Simpson, Fred. N., Pirie Street, Adelaide.
1925. †Smith, T. E. Barr, B.A., 25 Currie Street, Adelaide.
1927. Stapleton, P. S., Henley Beach, South Australia.
1922. Sutton, J., Fullarton Road, Netherby.
1932. Swan, D. C., B.Sc., Waite Agricultural Research Institute, Glen Osmond.
1925. Symons, Ivor G., Church Street, Highgate.
1929. *Taylor, John K., B.A., M.Sc., Waite Agricultural Research Institute, Glen Osmond.
1933. Taylor, Miss V., 40 Eton Street, Malvern.
1929. Tee, Sidney F., Adelaide Hospital.
1923. *Thomas, R. G., B.Sc., 29 Carter Street, Thorngate, S.A.
1923. *Tindale, N. B., B.Sc., South Australian Museum, Adelaide.

Date of Election.

1894. *Turner, A. Jefferis, M.D., F.E.S., Wickham Terrace, Brisbane, Queensland.
1925. Turner, Dudley C., National Chambers, King William Street, Adelaide.
1930. Walkley, A., B.A., B.Sc., Ph.D., 20 Urrbrae Avenue, Myrtle Bank.
1930. Walkley, Mrs. J. E., B.Sc., (Lon.), 20 Urrbrae Avenue, Myrtle Bank.
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ERRATA.

P. 86. "Folsom (110A)" should be "Folsom (13)."

P. 109. "Family Entomobryidea" should be "Family Entomobryoidea."

P. 246. "Fiscus platypoda" should be "Ficus platypoda."

P. 246. "Mastacomys fiscus" should be "Mastacomys fuscus."

Fig. 1

Fig. 2

Fig. 3

Fig. 4

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Fig. 1. The Arltunga Meteorite. About $^{3}/_{7}$ natural size.

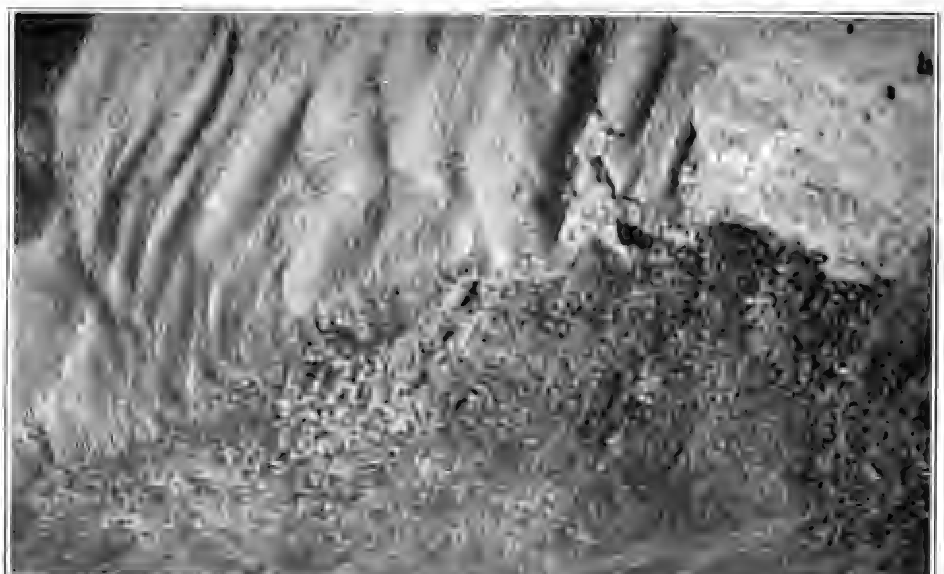

Fig 2. Portion of the surface of the Karoonda Meteorite. Magnification: x [illegible]

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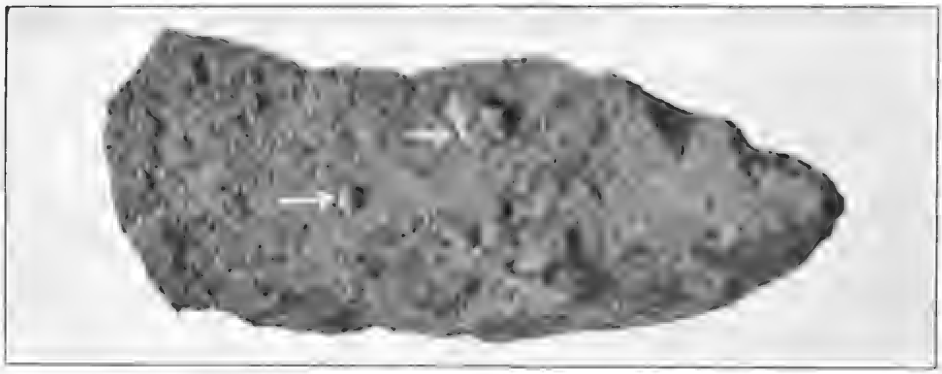

Fig. 1. The natural fracture-surface of the Karoonda Meteorite. Magnification: x

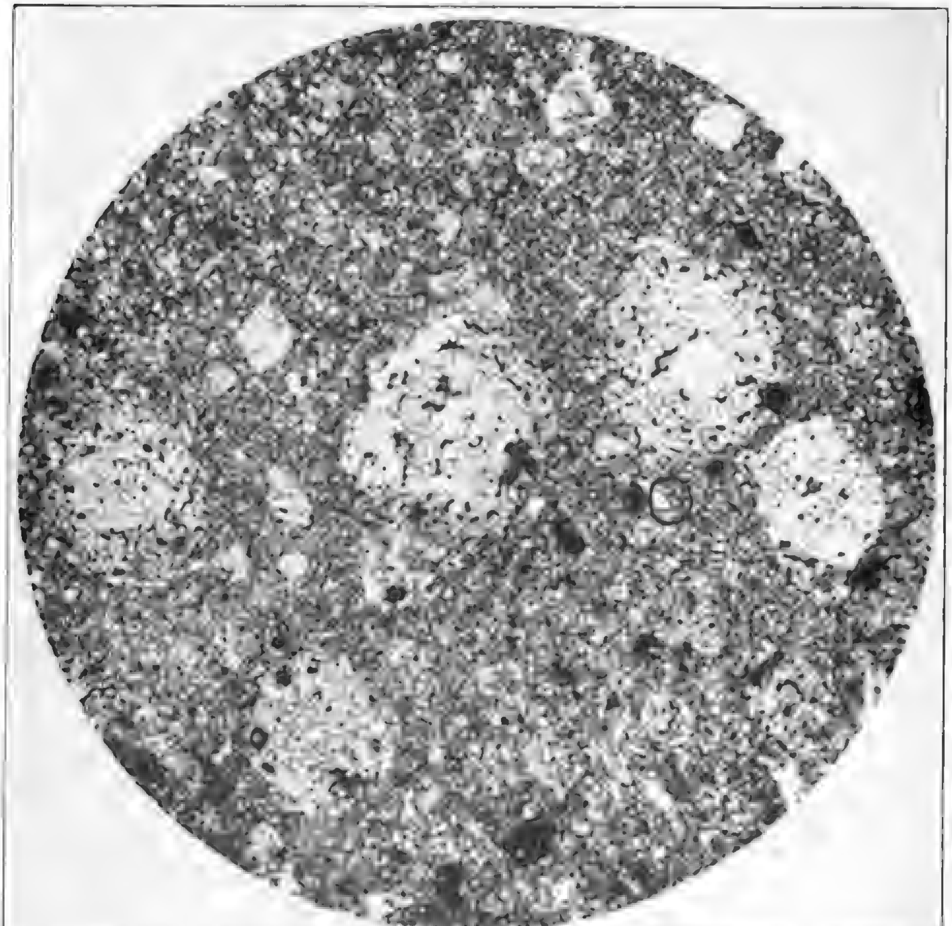

Fig. 2. Microscopic structure of the Karoonda Meteorite. Magnification: x 15.

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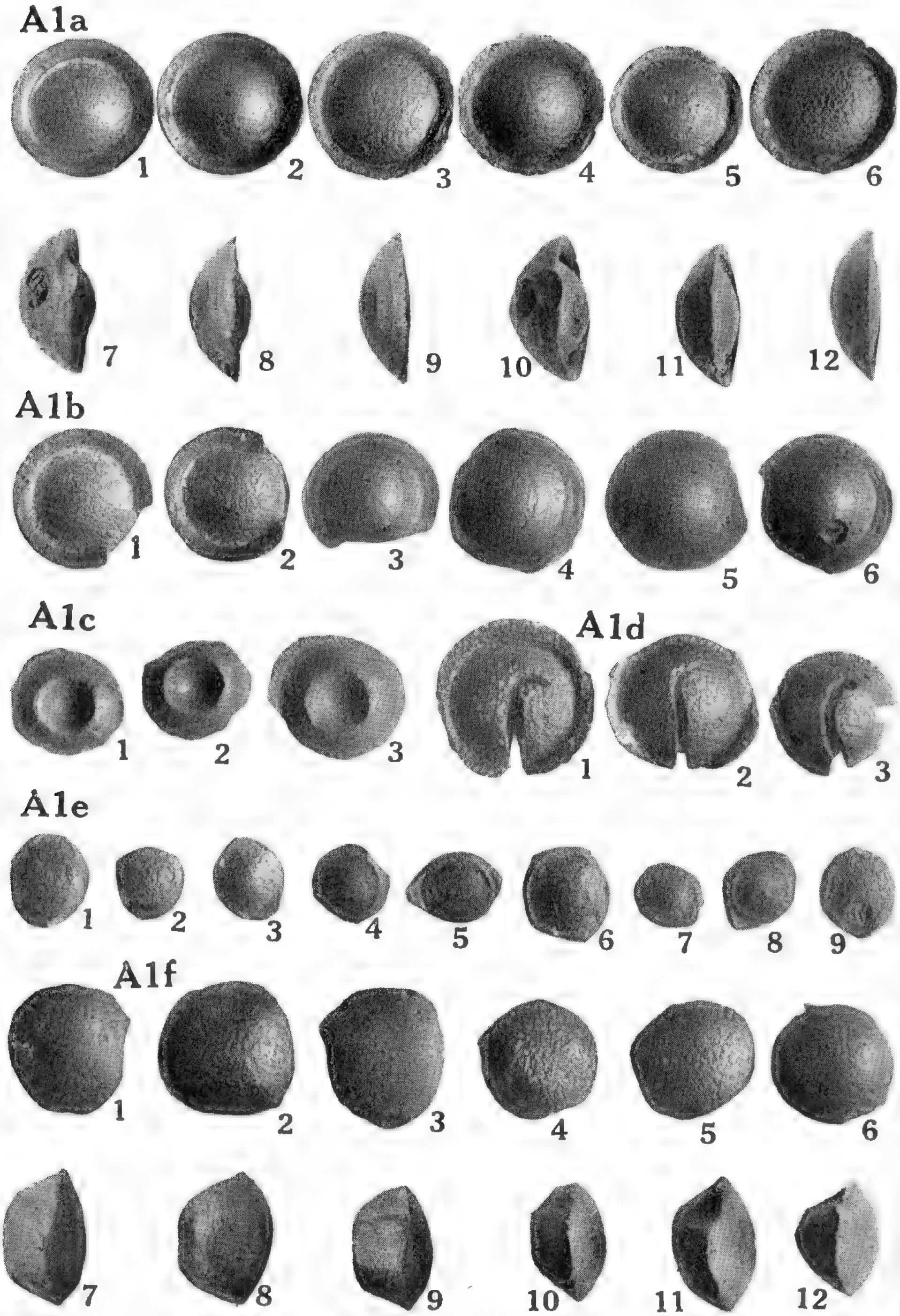

Australites. Button types, natural size; top, bottom and side views, as described in the context.

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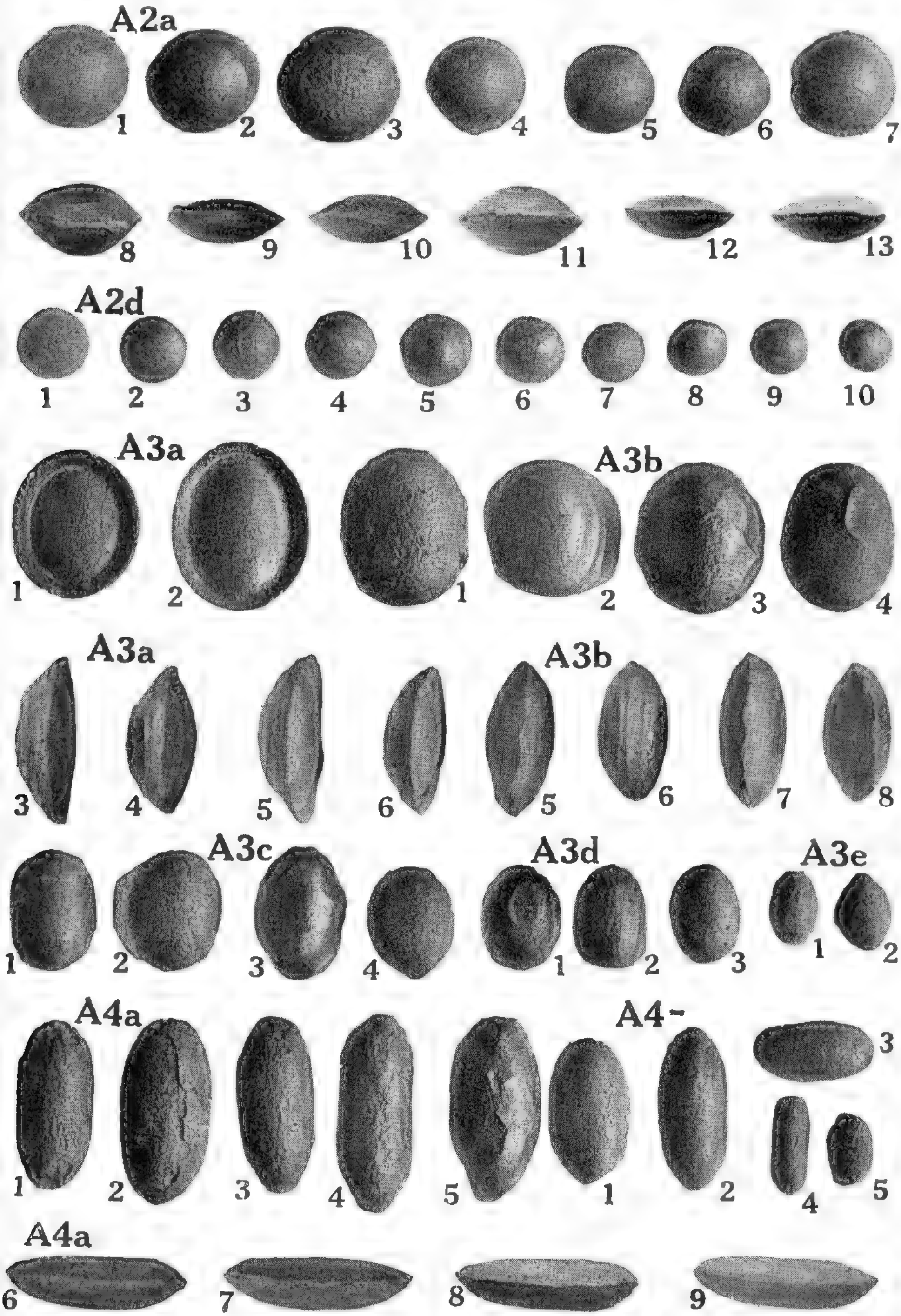

Australites. Lens, oval, and boat types, natural size; top, bottom, and side views, as described in the context.

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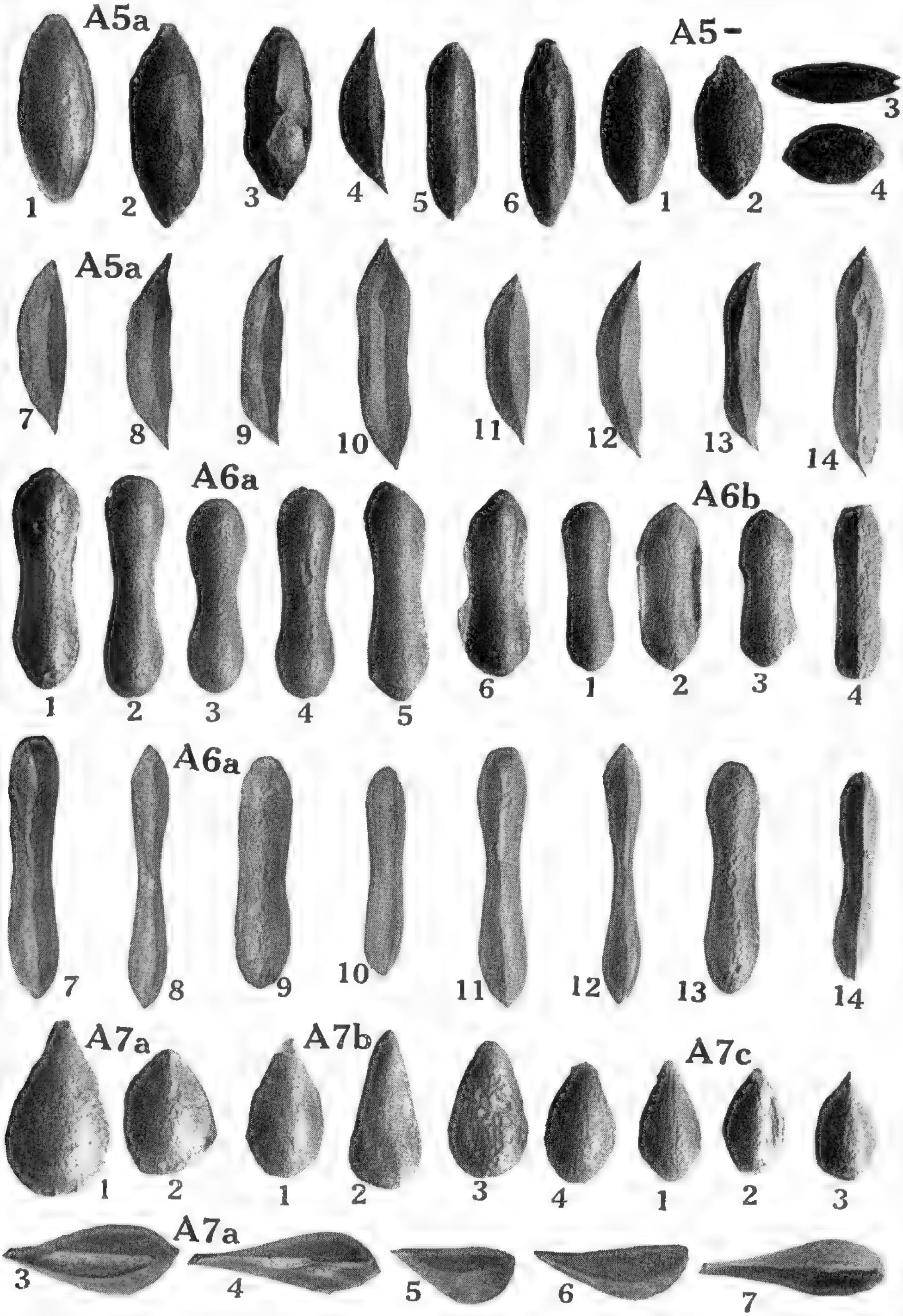

Australites. Canoe, dumbbell, and teardrop types, natural size; top, bottom and side views, as described in the context.

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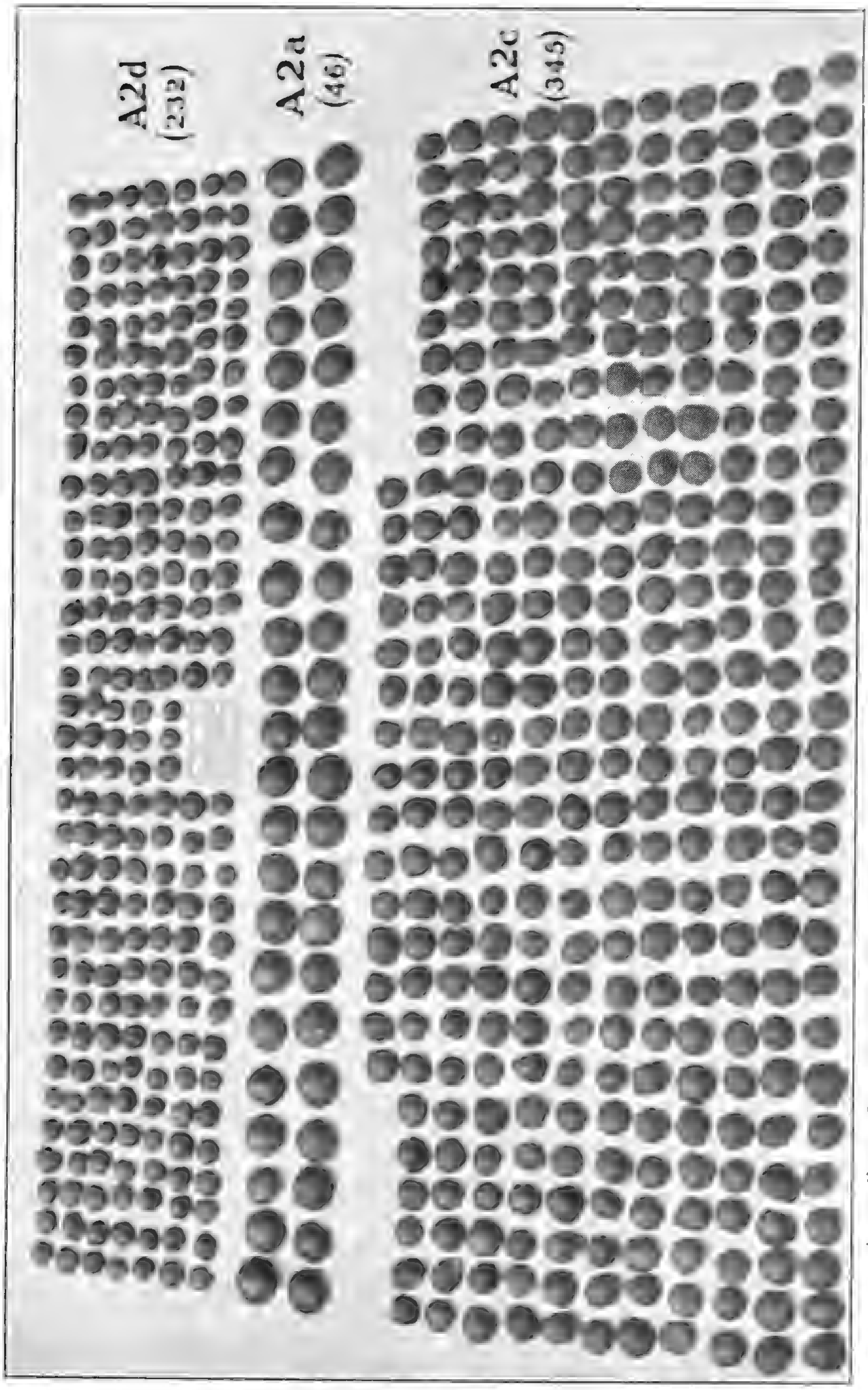
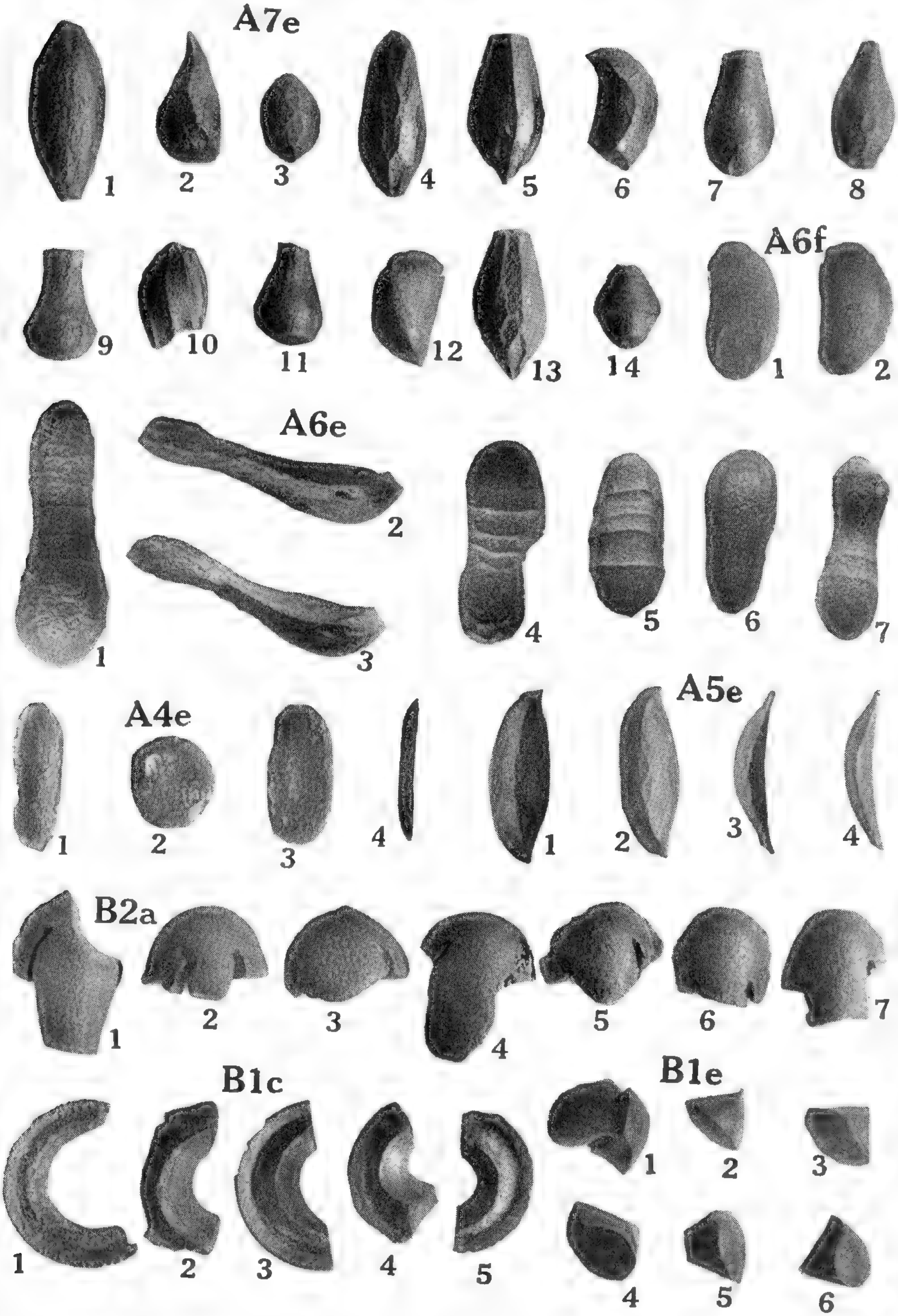


Australites. Lens type, reduced in scale; 623 of the 1,094 lens forms in the Shaw collection are shown here.



Australites. Various unusual and aberrant forms and fragments, as described in the context.

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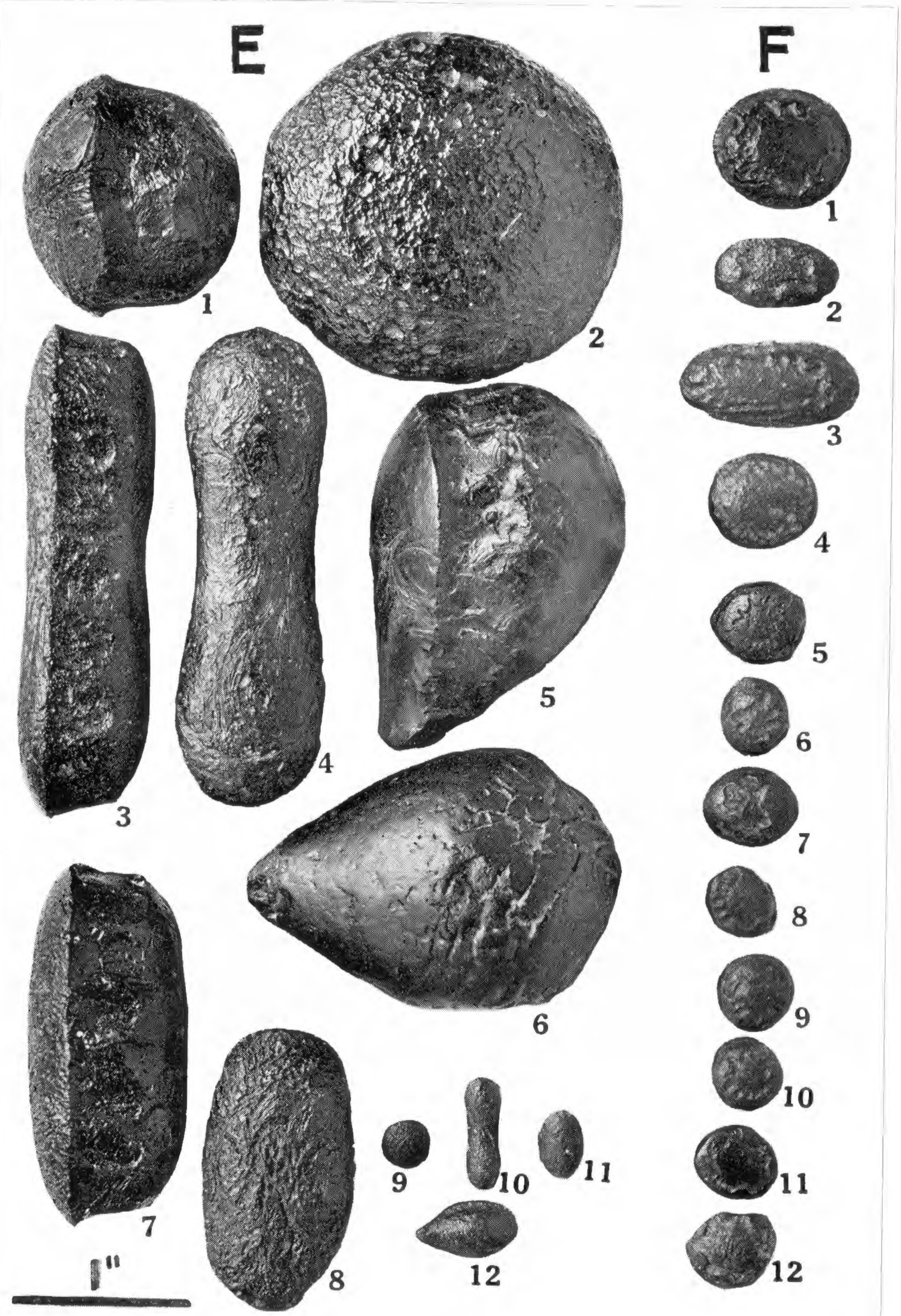

Various types of Australites. Natural size. The larger specimens do not belong to the Shaw collection, but illustrate various points in the context.

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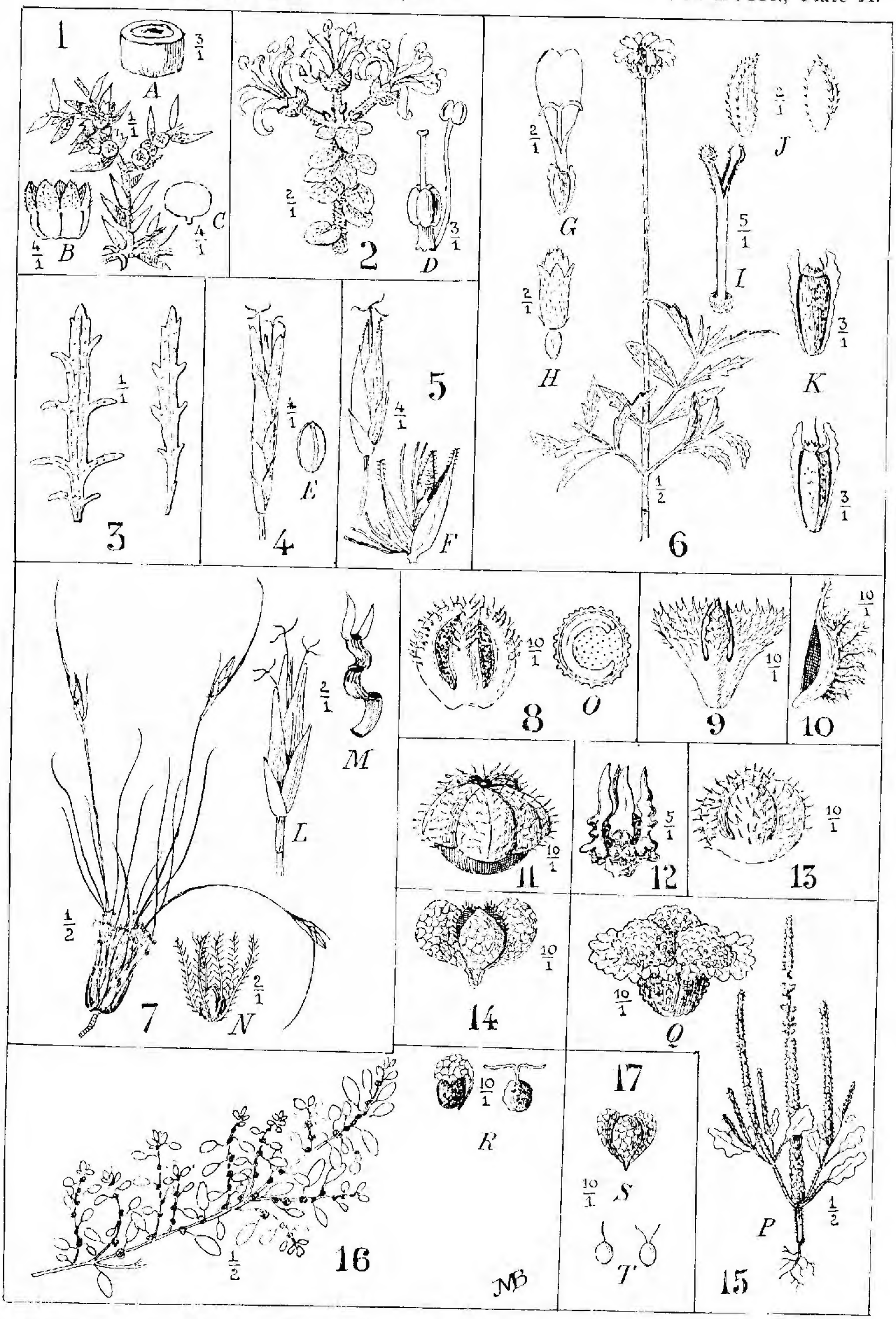
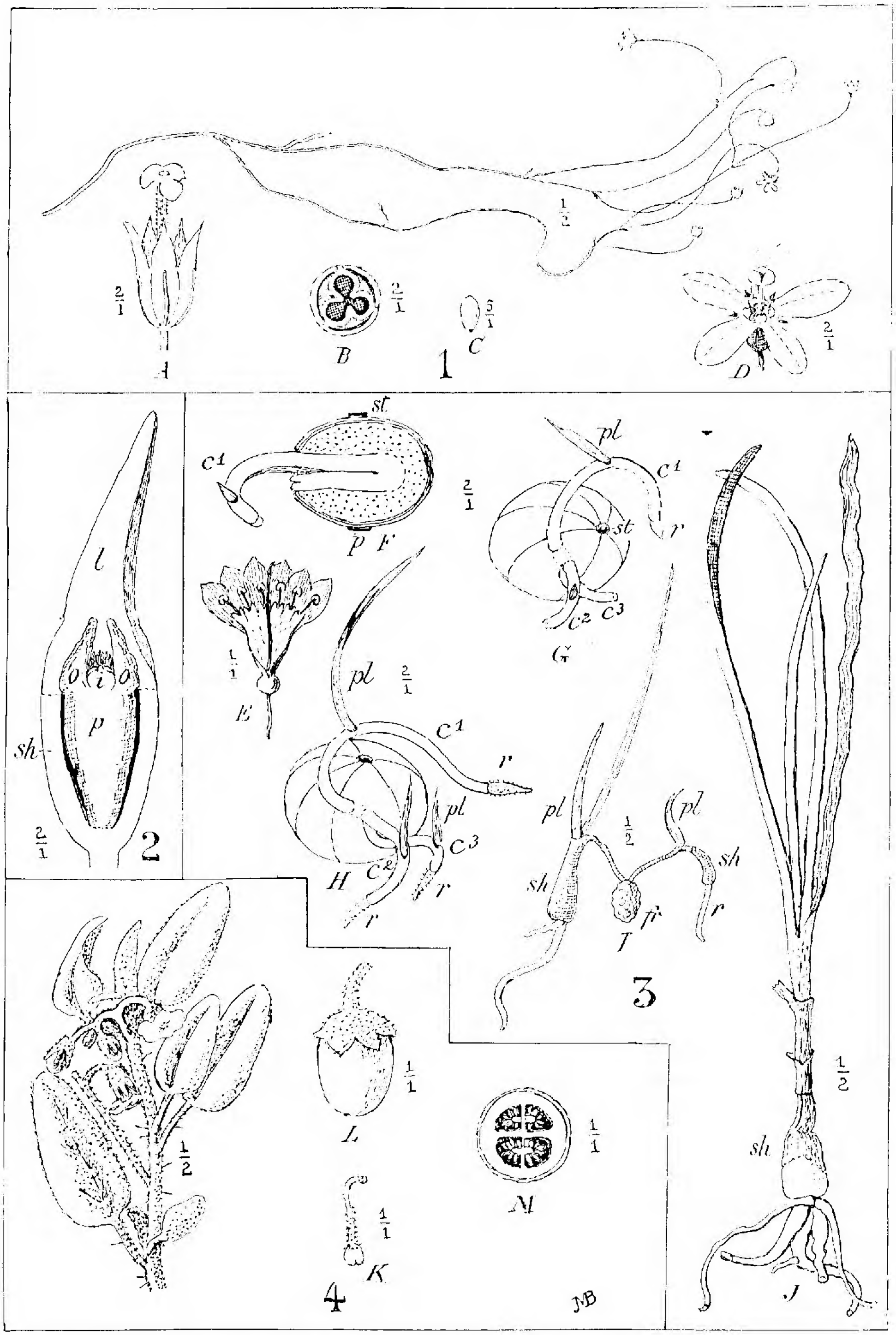


1. *Melaleuca monticola.* 2. *Phebalium brachyphyllum.* 3. *Pluchea dentex.* 4. *Tetraria monocarpa.* 5. *T. capillaris.* 6. *Wedelia verbesinoides.* 7. *Schoenus deformis.* 8. *Chenopodium pumilio.* 9. *Ch. carinatum.* 10. *Ch. cristatum.* 11. *Ch. melanocarpum.* 12. *Ch. atriplicinum.* 13. *Ch. rhadinostachyum.* 14. *Ch. plantaginellum.* 15. *Ch. simulans.* 16. *Ch. myriocephalum.* 17. *Ch. Blackianum.*



1. *Cephalostigma fluminale.* 2. *Sarcozona Pulleinei.* 3. *Calostemma purpureum.*
4. *Solanum centrale.*

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